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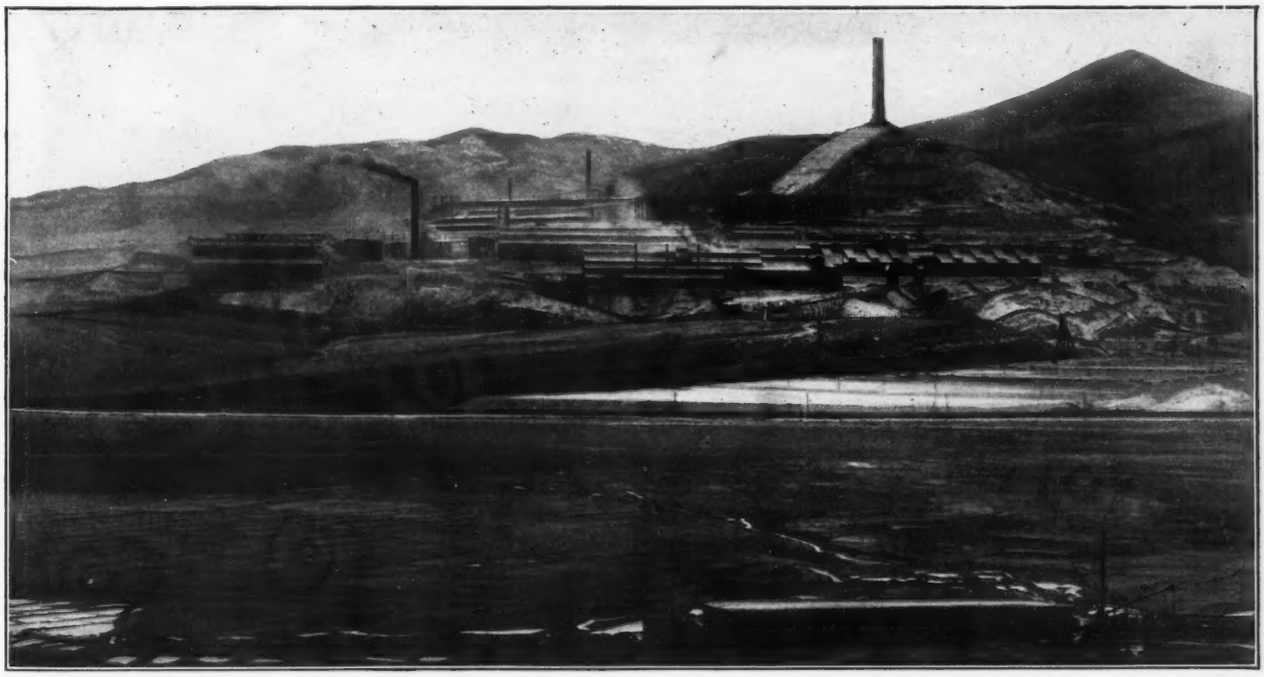
Oxyacetylene Welding in Mining

SYNOPSIS—Oxyacetylene welding is being used by some of the important mining companies, but its field for the prevention of lost time from breakdowns seems not yet generally appreciated. One of the largest repair jobs ever made with oxyacetylene apparatus was done by the Anaconda company in repairing its main dust flue; this work involved over 10 miles of welding. About 35,000 lin.ft. of welding was also done in the construction of the new round-table plant at Anaconda. A summary of what some of the large mining operators are doing with the oxyacetylene torch and what they think of its work.

Oxyacetylene welding by reason of its wide adaptability is particularly suited to mining repair work. It has already found a place at a number of important mines and some of the largest repair jobs ever made have been executed by mining companies. Yet the adoption of oxyacetylene welding is by no means as general in mines as it might be.

Today there are few general machine shops or foundries that have not made some application of autogenous welding both for emergency repairs and regular work. The work that it is possible to do with the oxyacetylene torch is so varied in character, the outfits so readily portable, and the time and money saved by their use are so evident that such outfits seem particularly suited to the requirements of mines generally. Many mines are distant from centers of supply; breakdowns to machinery unless promptly repaired mean a direct loss of income and perhaps a general increase in the cost of operation under part capacity while waiting for the broken pieces to be replaced or a new part to arrive from manufacturers. With a reliable repair outfit at hand, this situation may be avoided. The oxyacetylene outfit has found a place in other industries which need it less and hence seems destined to find a wider application at mining plants.

The apparatus consists essentially of a torch fitted with a tip and a mixing chamber connected by suitable tubes to the oxygen and the acetylene tanks or other sources of supply for these two gases, the combustion of which supplies the heat necessary for welding or cutting. The heat obtained is said to approach 6300° F. and is sufficient to melt readily any of the metals. The gases



THE ROOF OF THE 120-FT. DUST FLUE AT ANACONDA WAS WELDED BY THE OXYACETYLENE PROCESS

This was probably the largest single repair job ever done with the oxyacetylene apparatus; in replacing the roof of this flue, over 10 miles of welding was done, requiring 350,000 cu.ft. of oxygen and 40,000 lb. of calcium carbide

may be purchased in tanks or may be generated at the place where used, depending on conditions of supply and transport.

Character of Work Done at the Mines

A few mines installed oxyacetylene welding and cutting apparatus when it was first put upon the market, and have found these outfits extremely useful. In response to an inquiry, the managers at some of the important mines have reported their experience with the oxyacetylene outfits; in general, the apparatus has given excellent satisfaction; in a number of cases the managers have written that they would not be without a welding outfit hereafter. Repairs reported from these mines have included welding the dies and throttle handles of a drill sharpener, repairing valve handles, feed screws, front-head caps and air-chest stoppers for rock drills, a steel crusher pitman, welding a crack in the valve box of a pump, an engine cylinder head, brake arms on a hoisting engine, a spoke of a 14-ft. sheave wheel, welding in a piece 16 in. in length that was broken out of the rim of a 5-ft. gear wheel, a crack in the frame of a compressor, cutting the manganese-steel lips of dredge buckets that did not articulate properly, trimming the ragged edge of a cast-steel converter shell, welding converter windboxes and tuyeres, blast-furnace water jackets, welding a large smelting flue to prevent water leaking in and to increase draft, welding launders and classifying cones, straightening buckled wire screens and many other repairs of a miscellaneous character such as arise from day to day at the mines and reduction plants.

Among the well known mining companies already using oxyacetylene welding for repair work are the Anaconda Copper Mining Co., Alaska Treadwell Gold Mining Co., Empire Mines of Grass Valley, Calif., Conrey Placer Mining Co., Pato Mines (Colombia), Ltd., of Oroville Dredging Co., Copper Queen Consolidated Mining Co., Nevada Consolidated Copper Co., Desloge Consolidated Lead Co., Republic Iron & Steel Co., Shenango Furnace Co., Butte & Superior Copper Co., New Jersey Zinc Co., Ray Consolidated Copper Co. Some mines, situated in camps having repair shops, do not maintain a welding outfit of their own, but find it more economical to have their welding done in the nearby shops which may have more regular work for the apparatus. For example, in Butte, the Mountaineer Welding Co. with its Vulcan apparatus makes a specialty of repairs for Butte mines and works, and also does miscellaneous work for mines throughout the state.

Welding the Main Dust Flue at Anaconda

Perhaps the largest single repair job ever made with oxyacetylene apparatus was the welding of the roof of the main dust flue at Anaconda, Mont. The engineers of the Anaconda Copper Mining Co. report that they have occasion every day to make various repair jobs by means of oxyacetylene welding. The company has Davis-Bournonville apparatus with the following generators and accessories: Twenty-four electrolytic oxygen-generating cells, one purifier, one pressure regulator, two gasometers with regulators, one 2-stage compressor, one 300-lb. per sq.in. compressor and one 3-stage 2000-lb. compressor, 27 tanks for oxygen at 300-lb. pressure, 15 tanks for oxygen at 2000-lb. pressure. When using the welding apparatus, the oxygen consumption at Anaconda is about 1000 cu.ft. per day.

The original roof of the 120-ft. dust flue at Anaconda was composed of plates riveted to supporting I-beams; this was considered an exceptionally good roof and for years gave no trouble, but owing to the fact that an absolutely tight roof was impossible by this method, water would leak around the rivets and where the plates lapped. The moisture coming in contact with the dust underneath formed sulphuric acid, which in time corroded the sheets; the roof finally became so badly honeycombed that outside air being drawn in was responsible in great measure for the loss of draft in the flue.

So it was proposed to remove the old roof and put on new plates, welding them together to make an absolutely tight roof. The work was begun in October, 1913, and completed about 12 months later, during which time 53,365 lin.ft. of welding was done, using 350,000 cu.ft. of oxygen and about 40,000 lb. of calcium carbide. Owing to the large amount of welding involved, a plant was installed for furnishing oxygen. The first equipment was for 12 cells and later this was duplicated, making a total of 24 electrolytic cells for generating oxygen. The oxygen was compressed to 300 lb. per sq.in. and sent in tanks to the flue. For furnishing the acetylene gas, two generators were used. Work was started at the upper end of the flue near the stack and these generators were placed at convenient points beside the flue. The generators had to be moved three times during the progress of the work; when it was desired to move them they were put on cars on an incline hoist and lowered to new positions where they were placed on platforms previously prepared.

The manner of placing the steel plates may be described as follows: The 7-in. I-beams were drilled and tapped for ⅝-in. bolts; the plates were placed on the 7-in. beams and bolted on with ⅝x1-in. machine bolts and washers; the washers were welded to the roof plates to fill in the V-shaped holes that were made for the expansion of the sheets. The plates were placed ⅛ in. apart for welding. Some data regarding this large repair job are listed below:

Number of plates used	1711
Size and thickness of plates	No. 9—40x240 in.
Number of washers used	16,000
Size of washers	2 to 3½ in.
Linear feet of welding	53,365
Cubic feet of oxygen used	350,000
Pounds of calcium carbide used	40,000
Feet of ⅛-in. round Norway welding rod	100,000
Average number of men employed	11.5
Time required to complete work	12 months

Autogenous Welding of New Work

Another large welding job at Anaconda was in connection with the installation of the round-table plant. This plant comprises 20 tables of 20 decks each; the circular launders for collecting the discharge from each two decks were made of No. 10 steel and it was necessary to weld the bottom to the sides of these circular launders. The amount of welding in this job amounted to approximately 35,000 lin.ft. This method of making the launders was found to be cheaper than riveting and much more satisfactory, as it made an absolutely water-tight job.

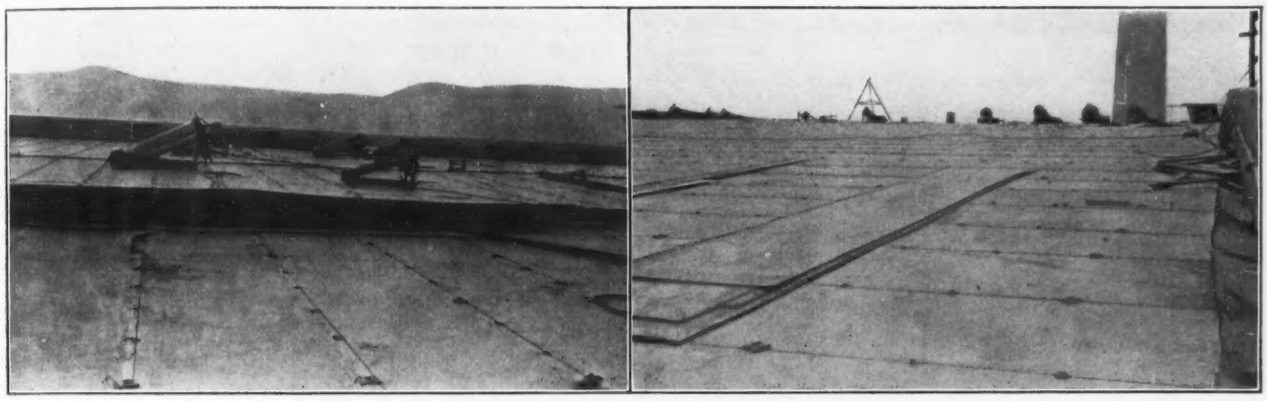
The Anaconda Copper Mining Co. has used the oxyacetylene apparatus for welding water jackets, but has since discontinued doing so because the oxyacetylene weld on the fire sheet would open and cause the jackets to leak. This failure of water-jacket welds does not seem to be in consonance with the experience at some of the other smelting works; some of the large manufacturers of water jackets also use the oxyacetylene apparatus for

welding. The repair welding jobs done around the Anaconda plant are of a general character, such as repairing castings, welding hoppers and other broken parts of cast and wrought metal. One of the accompanying illustrations show a "smoke box" used for experimental purposes; this particular work is interesting because the rather intricately shaped box was welded from very thin material, namely, 14-gage steel. In general the welds are regarded as possessing from 50 to 75% of the strength of the material welded, depending upon the conditions under which welding is done and also upon the skill and care taken by the operator.

At the Boston & Montana reduction department at Great Falls, Mont., the Anaconda company uses a Sanford portable welding machine purchased in 1910; also a Vulcan automatic acetylene generator added last year. At times the apparatus is used day and night for a week or more. The equipment is used not only for repairs and breakdowns, but also in the construction of new apparatus, such as water-jacketed blast-furnace spouts, blast-furnace jackets, converter windboxes and tuyeres, and classifying cones for the concentrator. The oxyacetylene-welding apparatus was extensively used at this reduction plant when changes were being made during reconstruction. With the oxyacetylene torch, it is possible to cut any kind of steel work quickly and accurately in place and the apparatus is useful in the field for cutting holes in or fitting parts to large pipes, tanks, furnace shells, etc. It is especially valuable where it is necessary to connect old equipment in place or in putting in new equipment, the exact connections for which are difficult to calculate and fabricate in the office or shop. It is also useful to repair such apparatus as converter shells on which large patches may be welded while the vessel is in place.

Among other work done in Montana by the Mountaineer Welding Co. was the manufacturing of 37 water jackets for the East Butte smelting works, the tuyeres in this case being welded with the oxyacetylene torch as well as the corners. The oxyacetylene torch was also used at this works to cut a straight line around the edge of the cast-steel converters, so that they could be lined up to the very edge with brick, the fused condition in places around the edge having previously prevented laying brick close to the shell. Numerous small castings and machine parts in cast iron, steel and bronze have also been welded for this company. At the Butte-Alex. Scott Mining Co. a compressor frame was broken, the crack extending for a distance of from 5 to 6 ft.; this was welded in one day and was thereafter in constant service.

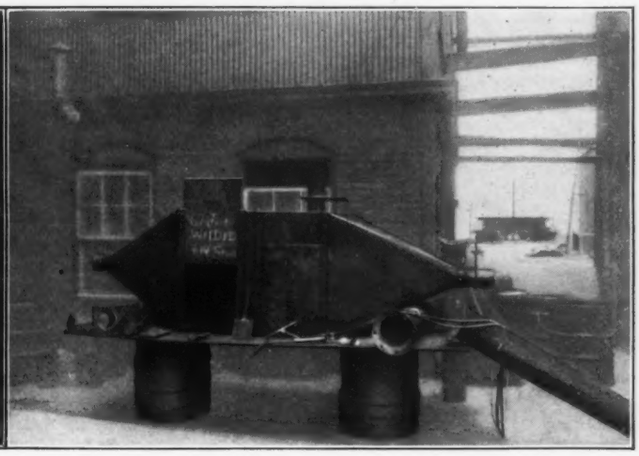
At Corbin, Mont., a roll bedplate belonging to the Boston & Corbin Copper & Silver Mining Co. was dropped 30 ft., breaking out nearly all of one side. The cast-iron bedplate weighed 7 tons, and the thickness of the metal varied from 1 to 3 in., and the total length of the break



ON THE FIRING LINE AT ANACONDA

The howitzer-like apparatus are the gas-supply tanks used in welding the roof of the main dust flue at Anaconda, Mont.

SOME 7-IN. I-BEAMS REMOVED FROM THE OLD ROOF OF THE ANACONDA FLUE



AN EXPERIMENTAL "SMOKE BOX" MADE WITH THE OXYACETYLENE TORCH AT ANACONDA

was about 10 ft. The work of welding was commenced at 10 p.m. by the crew of the Mountaineer Welding Co. and was finished at 10 p.m. on the following night, successfully. In preheating the bedplate, 29 sacks of charcoal were used.

Acetylene welding has been done at many of the Anaconda mines at Butte; at the Tramway mine a spoke of a 14-ft. sheave wheel was welded, the break having been approximately 7x9 in.; at the Mountain View mine a piston jammed into the cylinder head, breaking the head and carrying off the flange of the cylinder; the cylinder was 20 in. in diameter by 66 in., but the flange was welded back on successfully. At the Leonard mine two brake arms were welded on the hoisting engine between shifts, so that no time was lost in hoisting. A 5-ft. cast-steel gear wheel on one of the pumps at the Original mine was broken for about 16 in. along the rim. This was welded in a few hours' time; other pump parts, including those of phosphor-bronze, have been welded with the oxyacetylene apparatus.

Acetylene Torch for Gold-Dredge Repairs

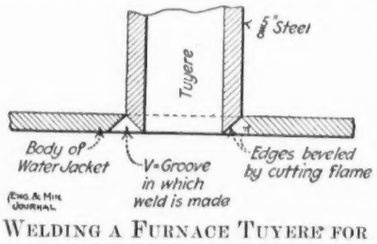
At one of the dredges of the Conrey Placer Mining Co., the Mountaineer Welding Co. reports using a Vulcan apparatus to cut off the manganese-steel lips of 84 dredge buckets which did not have enough clearance, each bucket striking the bottom of the preceding bucket. The lips of the buckets were 20 in. across and the dimension of the cut was from 1¼ to 2¼ in. by 20 in., making a total of 140 lin.ft. This work eliminated the striking of the buckets, and the total cutting time is reported as 6 hr., whereas to have done this work by any other method would have tied up the dredge for several months—an extremely expensive delay both in the matter of interest on investment and in the loss of yield from the dredge. Acetylene welding has also been done for the Marysville Dredging Co., Marigold, Calif., the Pato Mines, Ltd., in Colombia, and possibly by others, as no inquiries were made among dredging companies.

Experiences of Various Companies

The Empire Mines at Grass Valley, Calif., has an oxyacetylene-welding outfit purchased from the Great Western Cutting & Welding Co. and the manager reports that it was satisfactory in welding cast iron, but that good results were not uniformly obtained in welding hard steel or in getting the welded steel to hold a temper. The apparatus has been used to weld dies and throttle handles of the drill sharpener, a lug on the brush holder of a dynamo, building up a brass nut on a lathe, repairing gas burners, welding copper plates for the amalgamating mill, valve pots of pumps, feed screws, valve handles, frontheads caps and air-chest stoppers for rock drills, besides various small repair jobs on cast-iron parts of different machines around the mines. The largest piece of welding this company has done was in repairing the cylinder of a locomotive for the Nevada County Narrow-Gage Ry. One of the follower bolts of the piston head broke and dropped between the piston and cylinder head, causing the piston to pound and knock out the cylinder head, carrying away a large piece of the cylinder; the cylinder was 18 in. in diameter, and the break extended about 3 in. into the bore of the cylinder and about one-half way around, tapering out at the end. The piece was welded and the cylinder ground out, and the job considered an entire success. The cost of replacing the cylinder would have been several hundred dollars, while the cost of welding was only $13.87, and the time of preparing and welding only eight hours.

The Copper Queen company at Douglas has an oxyacetylene outfit made by the Alexander Milburn Co., of Baltimore, Md., and uses it principally for welding soft steel, such as for water jackets, pipe work, etc. The company also does repair work for the Calumet & Arizona smelting works at Douglas. Welds are figured to have a strength of about 50% of the original sheets. The Nevada Consolidated Copper Co. uses a Fouche welding apparatus mainly on small work, such as sample cutters, small tanks and small broken castings. The management reports that the oxyacetylene flame is extremely useful in cutting openings in heavy plate, such as converter shells, etc., and would not be without an apparatus of this kind, notwithstanding the company has for a long time used Thermit welding also. The latter is used on heavy work such as large shafts, etc.; a satisfactory weld was made on an impeller of a No. 10 Connersville blower with Thermit, after failing with oxyacetylene.

The Desloge Consolidated Lead Co., in southeastern Missouri, has had emergency welding done by the oxyacetylene method on numerous occasions. Last autumn a steel crusher pitman was broken; two men in 56 hr. of practically continuous work restored the pitman to virtually normal condition and saved a long delay on the crusher. The company up to the present has not purchased an equipment of its own on account of its proximity to St. Louis, where it is possible to get men and material on short notice. It has had welding of both steel and cast-iron parts done, such as repairs to engines, pumps, Hancock jigs, and other small parts, and has found these parts to hold as well as they did originally.



Welding a Furnace Tuyere for the East Butte Works

The Shenango Furnace Co. at Sharpsville, Penn., uses an Oxweld Acetylene Co.'s outfit to weld various jobs both of cast iron and cast steel, and has had no trouble with any welds, some of which were made two years ago. The Republic Iron & Steel Co., at Thomas, Ala., has had oxyacetylene welding done, although it has never purchased a welding apparatus; it has applied this process mainly to cast-iron controller handles and cast-iron scale beams, which up to date have proved satisfactory.

The Alaska Treadwell Gold Mining Co. has purchased an oxyacetylene-welding apparatus from the Davis-Bournonville Co. of New York, but at the time this inquiry was made, had done no work therewith, except experimentally.

The Butte & Superior Copper Co. has a Bermo oxyacetylene-welding apparatus; though the first jobs were more or less unsuccessful, at present it is unusual to have a defective or unsatisfactory weld. The work is of course intermittent and irregular in character, but there are times, according to the mill superintendent, when a small weld is necessary on a big casting where welding will

show a large economy, both in time and money over the purchase of new parts.

The New Jersey Zinc Co. has an oxyacetylene apparatus at its Palmerton plant and has loaned this on several occasions to the mines at Franklin Furnace, N. J. It has been used there for cutting off plates in inaccessible places and repairing a cylinder head; the latter job was unsatisfactory, but the company reports good results in replacing broken teeth on gear wheels and other minor parts, but states that not enough work has been done at the mines as to warrant definite conclusions as to the durability of the work.

The Ray Consolidated Copper Co., at Ray, Ariz., has installed an oxyacetylene-welding machine made by the Economy Welding Machine Co., Kansas City, Mo. This is used almost daily on small jobs welding various parts made of cast iron, steel and brass. No large jobs have yet been undertaken. Mr. Cates directs attention to the fact that "the insurance underwriters claim that 10% of the oxyacetylene machines explode each year" and that in installing them a concrete building should be provided, and that the oxygen generator should be housed in one cell and the acetylene generator in another so that there shall be no mixing of these gases except through the proper tubes.

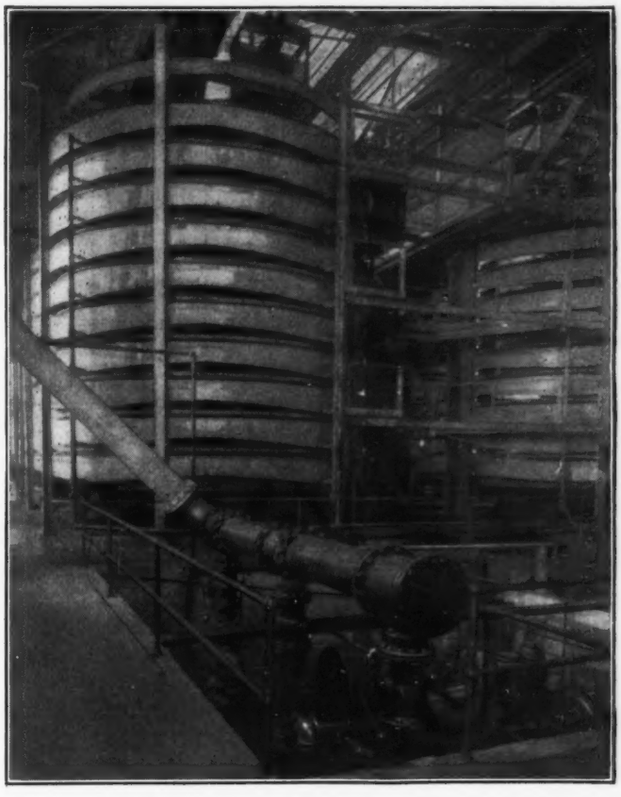
Strength of Welds

Concerning the strength of oxyacetylene welds, A. Campion and W. C. Grey reported[1] at the Conference of Shipbuilders and Engineers the results of a series of experiments which they made. They state that the tensile strength of welded mild-steel bars (0.25% C) varied considerably, showing an average strength of about four-fifths and a ductility of about one-fifth of the unwelded steel. Repeated impact tests made in a Stanton machine also gave variable results. Hammering was the most effective treatment for increasing the fatigue-resisting properties of the material, but the hammering should be done with the metal at full red heat (800° C.) to remove strains and brittleness which might result from hammering the comparatively cool metal near the weld. Reheating and annealing alone did not increase the fatigue resistance of the welded portion. The form of treatment which gave the highest strength in tension gave the lowest results in impact tests. Fracture tests in the overheated portion of the metal adjacent to the weld gave even more variations than the test at the weld itself, but reheating to 800° C. restored the material nearly to its original strength. Impact tests on places of different thickness showed clearly that the thicker the plate the less reliable the weld and the greater the reduction in strength. These investigators concluded that autogenous welds must always be regarded as somewhat uncertain and therefore should be accepted with extreme caution, if not entirely prohibited, in cases where failure would tend to endanger life or limb.

The experience of the mining operators varies as to the strength of oxyacetylene welds, some estimating them at 50%, while others considered them as strong as the original parts as no further breakage occurred. Much undoubtedly depends on the skill and care of the operators. Welds that look good on the outside may not be at all well done and may fail in service. The application of the heat and the complete fusing of the metal without burning require a high degree of skill, and the success of a weld is almost wholly in the hands of the operator.

[1] "Times Engineering Supplement," July 31, 1914.

The enumerations of the work performed by the above mining companies with the oxyacetylene torch are sufficient to show that it has an important place in mining work, not only in getting operations going again after a breakdown but also in new construction, as reported at Great Falls, and in the building of the circular launders for the round-table plant at Anaconda. Contractors in laying pipe have used oxyacetylene apparatus for joining the lengths, instead of couplings, and this may indicate possibilities in connection with the water supply of mining companies, and especially in making changes in the pipe line without waiting for new fittings to arrive. New buildings have been piped in this way without the use of any fittings, but it is impracticable within the scope of this article to indicate all the possibilities of acetylene welding. It is merely desired to show what some mining companies are doing with acetylene welding and where others may profitably apply this process.



THE CIRCULAR LAUNDERS WERE CONSTRUCTED WITH THE OXYACETYLENE TORCH

There were about 35,000 lin.ft. of welding done with the oxyacetylene apparatus in constructing the launders for the 20-deck tables in the round-table plant at Anaconda. This method was found cheaper and better than riveting, as it makes a water-tight launder.

Chino Copper Co.

The report of the Chino Copper Co. for the last quarter of 1914 shows a production of 8,935,585 lb. of copper: 3,060,000 lb. in October, 3,047,694 lb. in November and 2,827,891 lb. in December. Total production of copper in concentrates for the year was 54,748,254 lb. There were no crude-ore shipments in the last quarter, but from

previous quarters of the year 2,093,723 lb. were thus produced.

Of the 347,200 dry tons of ore treated in the fourth quarter, 35% came from the North orebody, 2.1% from the Northwest orebody and 62.9% from the South orebody. Average copper content of the ore treated during the quarter was 1.8612%, and average extraction was 69.14%, corresponding to a recovery of 25.736 lb. of copper per ton of ore treated.

Cost per pound of net copper produced, after allowing for smelter deductions and without allowing any other credits, was 8.14c. By allowing all credits from miscellaneous sources, the cost of copper is reduced to 7.71c. per lb. These costs include all charges, together with 30c. per ton of ore treated for the extinguishment of mine development and stripping expense.

Net surplus over dividend requirements for 1914 was $1,024,449. During the last quarter 603,871 cu.yd. of material in place was moved, of which 413,099 cu.yd. were stripping and the remainder ore. Earnings are based on a carrying price of 11.08c. per lb. for copper, during the quarter.

Economics of the War

In an address on "The Political Economy of the War" at Sheffield, Jan. 22, Francis W. Hirst, editor of the *Economist*, said that at the commencement of the war he estimated that it would cost the leading belligerents about $50,000,000 a day, made up roughly as follows:

Russia	$12,500,000
Germany	12,500,000
France	8,750,000
Austria	8,750,000
Great Britain	7,500,000

Now that 170 days of the war had passed, Mr. Hirst said, it meant that the war had cost Europe $8,500,000,000, of which amount Great Britain had contributed $1,275,000,000. This was only the direct financial cost.

The computation left out the expenditures of the Belgian, Servian and Japanese Governments, as well as the millions which had been raised by various neutral countries in mobilization and war preparations. It left out altogether the indirect losses of commerce all over the world and the actual destruction of property in Belgium, France, East Prussia, Russian Poland and Austrian Galicia.

Worse still, it omitted that awful item, the capital value of men killed or maimed or dead of disease in the prime of their manhood. Actuaries whom he had consulted put the average value of an English soldier at not less than $4000.

On the Paris Bourse, at the end of 1914—business having then been resumed since Dec. 7—the average price of fixed-revenue securities, as figured out by the *Economiste Francais*, was 12 to 15% lower than at the end of 1913. The *Economiste* assumes this to mean a rise of at least ½% in the average cost of capital. But it adds:

> A decline of 12 to 15% in prices does not seem anything enormous, if one considers the huge emissions of home and foreign government securities which are under way. In October it was estimated that, if the war were to continue seven months (which would have fixed its termination around the end of February), the direct war expenditure of all the belligerents combined would have been 50,000,000,000 francs.
>
> The outlook now is that the war will last four or five months longer—say to the end of June. It is undoubtedly impossible to make anything like exact calculations in such matters. But the direct losses of the war up to such a date, combined with the public loans of belligerents and neutrals arising from the war, seem bound to reach at least 80,000,000,000 francs, and they may approach a hundred thousand millions.

In American values, this would be $20,000,000,000. In 1907, when explaining the reason for the strain which then existed on all the world's stock exchanges and money markets, M. Leroy-Beaulieu, in the *Economiste Francais*, estimated that new capital accruing in the civilized world each year, available for investment in securities, was $2,400,000,000. There had been, in 1907, he added, a demand for much more; "but the world has not got it; therefore, it cannot provide it." Yet in this present season, since the end of August, the German Government has borrowed $1,100,000,000 on a war loan and the British Government $1,750,000,000; so that in hardly half a year, more capital has been called for, by only two governments, than the French economist's estimate of a full year's available sum of new capital in all the world.

A writer in the New York *Evening Post* is an exponent of more optimistic views. He says that it is possible to view the extraordinary financial contingencies of Europe with something of equanimity. Reverting to the question of human initiative, it is a fair assumption that the burdens of debt and taxation which Europe is now assuming may prove a stimulus rather than otherwise. It is at least an admissible theory that the more the European Governments take from their subjects in the way of taxation, the harder their subjects will work to offset such a burden by increased industrial gains. This was certainly the case in England after 1815 and in France after 1871. To sum it all up, the best sentiment is that this is a very rich world and that it is not going to be disastrously impoverished by this war; that both here and abroad, everyone is going to be keener than ever before to get down to work; and that Europe, instead of selling us out, will be eager to cultivate closer and more binding financial and industrial relations with us than in the past. This is looking at the situation in the largest way. If one looks at it in any other way, he finds himself in a maze.

The fairly prosperous situation of Russian industries, as reported by the Minister of Finance, and the highly beneficial results of the prohibition of vodka have recently been mentioned.

We have upon several occasions referred to the economic aspects of prisoners of war. Bearing upon this subject it was announced from Essen, Feb. 11, that the Westphalian coal-mine owners had reached an agreement with the military authorities for supplies of prisoners of war to work their mines, this step being taken in order to relieve the scarcity of labor, which has become acute within the last few months. The mine owners have been trying in vain to keep the production of coal equal to the requirements of the market. These have increased as a result of the big demands for military purposes. The owners have not been able to produce coal as fast as it was wanted, and they will now be supplied with prisoners of war to help. The military authorities purpose to select from among French, Belgian and Russian prisoners men who have previously worked in mines. Camps for their accommodation already have been established in the coal-mining districts.

A Short-Line Railway in Chile is planned between Talagante on the San Antonia, Melipilla and Santiago line, and Paine, on the Longitudinal Ry., according to "Commerce Reports."

Effect of Increased Reduction on Blake-Type Crushers

By Milton W. Heller*

SYNOPSIS—Reduction of the size of crusher product by setting the jaws close together is wasteful of power. A more economical installation is a machine adjusted to crushing requirements and operated at maximum efficiency. Much error is current regarding the capacity of crushers when making different products.

At few mills has it been necessary to work crushers up to their maximum capacity. The fact that in most cases the crushers are fed by an amount of material limited by the capacity of the following machinery, is perhaps the most significant reason for this. In other instances, a liberal allowance has been made in the selection of the crusher.

Whether the crusher be worked to capacity or not, a saving in power cost can be effected by the installation of the smallest possible machine. The crusher at its best is a cumbersome piece of machinery with heavy moving parts. It has been found that approximately 70% of the power used on the crusher is used when the machine is running empty. If it is considered that perhaps 50% of the run-of-mine material requires no breaking on the large first crusher, the possible capacity, indicated by the mouth size of the crusher, is not used, and for a great part of the time the crusher turns over doing no work and there is a consequent loss of power.

The disregard of these facts has led to the installation of larger crushers than required. To economize this lost power some plants have tried to increase the amount of reduction. As the machine was originally underloaded, no doubt it would handle the load put on it, but this condition was long since expressed by W. P. Blake:

"When importance of getting a finer product leads in many cases to setting the jaws closely together, which, of course, increases the friction and wear upon the lower parts of the faces of the jaws, and it may be said that although by setting the jaws very close together . . . a larger amount of fine stuff can be produced by an ordinary rock breaker, it is not an economical use of the machine, which was never designed to be so used."

What then are the factors controlling this degree of reduction and along what line should crushers be designed to meet these demands in the most satisfactory way?

Admitting that a crusher working all the time at breaking rock is working more economically than if it were running idle for part of the time, it is essential to have a crusher of the smallest size which will have the required capacity.

Heretofore it seems that mill men have closely connected "mouth-size" with the capacity of the crusher, and manufacturers have followed lines that would satisfy this idea. Only vague guesses are given as to the effect of a variation in the size of product upon the output, and in all instances, these guesses favor the machine. Of several standard types, the actual gap fails to meet the stated mouth-size, the measurement having been taken between favorable points, and a "trade" standard given. This is more apparent in the larger sizes, where the increase of mouth-size greatly increases the amount of iron put into the machine. One 13x24-in. machine was found to measure 11½ in., and a 15x24-in. measured only 13½ inches.

Given a certain size crusher operating at a given speed and power, the capacity of the machine will depend only upon the time necessary for the rock to pass through the jaws. This time depends upon three factors; the time consumed before the jaw makes the first break; the breaking character of the rock, i.e., the number of pieces formed per break, and the size of the discharge opening.

The relation of the amount of fine stuff going through compared to the amount that must have actual work done upon it, would not influence the result appreciably, for at the high rate of vibration of the machine, 300 r.p.m., the fine stuff cannot cling to the larger pieces, but has free passage.

Obviously in a machine making 300 r.p.m and traveling but a short distance, the effect of the impact of the jaw is not great enough to break the piece. If the piece is not gripped and squeezed, perhaps the maximum result is breaking of the edges so that this grip can take place. The time taken before a piece is nipped is of greater importance than is generally recognized. A few seconds at most on one piece will rapidly amount to something as thousands of pieces go through.

Richards, in his "Ore Dressing," Vol. I., p. 94, shows mathematically that with a coëfficient of friction of 0.3, rolls will take a particle when the angle of nip is approximately 16°. The theory holds likewise in a Blake-type jaw crusher when the resultant breaking force passes below the center of gravity of the piece. It should be remembered that whereas in the rolls the force keeping the piece in the zone of action is the difference of frictional force on the roll and the component of the normal force tending to throw the particle out, the force keeping the piece in the crusher in the zone of action is likewise the difference of the frictional force, holding the piece against its movement up the jaw and the component tending to throw it up.

When it is observed that the material fed to crushers is for the most part wet, as it comes from the mine, or dampened to reduce the dust, it is apparent the water exerts a lubricating effect, which is further augmented should any clayey material be present. This condition might at any time bring the coefficient of friction down to 0.2. Again using Richards' formulas, the angle of nip would have to be 11° or under before a bite would occur.

The great variety of shapes and sizes fed to a crusher, as compared with the rather uniform product to the rolls, would indicate that whereas a roll operating with an angle of nip of 16° is just on the danger point, a crusher so operated would have exceeded it. From this reasoning it would appear correct that the angles between the jaws

*Mining engineer, 1331 Corona St., Denver, Colo.

of a crusher should not exceed 12° to work near its utmost capacity.

By referring to the accompanying table, it is readily seen what degree of reduction under present standard measurements of construction will bring the jaw angle about this limit:

DEGREE OF REDUCTION AND JAW ANGLE

Size of Crusher, In.	Actual Width Opening, In.	Length Vertical Jaw, In.	Set to Crush to, In.	Angle Between Jaws
4x 7	4	12	½	15° 50′
			1	13° 45′
			1½	11° 50′
			2	9° 25′
7x10	6½	17½	1	16° 30′
			1½	15° 0′
			2	13° 15′
			3	10° 30′
9x15	8½	24	1½	15° 25′
			2½	13° 10′
			3	12° 0′
			4	9° 30′
10x20	8½	26	1½	14° 40′
			3	11° 30′
			4	9° 40′
13x24	11½	33	1½	16° 30′
			3	14° 15′
			4	12° 30′
			5	11° 0′
15x24	13½	33	1½	22° 30′
			2	21° 45′
			3	20° 30′
			4	18° 30′
			5	17° 15′
			6	15° 20′
			7½	13° 30′

The manufacturers, no doubt, have exceeded this angle because it gave them the mouth-size that was sought for the least cost. The direction that has been taken to increase crusher capacity has been to make a wider jaw. It would have been better if the jaw angle had been made smaller, and the additional iron put into the height of the jaw, rather than the width. The second point, the breaking character of the rock, is important, but is a character outside of our control.

It is readily admitted that a decrease in the size of the discharge opening will reduce the capacity. This amount of reduction is, however, greatly underestimated. Extending the principle given by Richards in Vol. I, p. 35, of his "Ore Dressing," we may argue that in a 15x24-in. breaker, if one 15-in. cube reports at the mouth in 125 3-in. cubes, then the capacity at the mouth is 125 times that at the throat when breaking to 3 in. If, now, the crushing be reduced to 1½ in., there would be 1000 cubes produced, and the capacity would be 1000 times greater at the mouth than at the throat. The capacity, then, in the second case would be theoretically but one-eighth of that in the first case.

With the smaller opening there would be a proportionally larger amount of material that would have to be worked on, as with a smaller opening the probability of more stuff being smaller than that opening would be increased. This would have an added effect in reducing the output. As an illustration of how much this capacity reduction is underestimated, apply the principle stated to the catalog capacity of a 15x24-in. crusher:

COMPARISON OF CAPACITIES

Approximate capacity for 24 hours.

Break to	3 in.	2½ in.	2 in.
Tons	600	480	420

THEORETICAL

Break to	3 in.	2½ in.	2 in.	1½ in.
Tons	600	347	177	75

An analysis of a catalog table will show the error of basing estimates upon the figures given.

APPROXIMATE CAPACITY IN TONS PER DAY OF 10 HOURS

Size	Tons	In.	Tons	In.	Tons	In.	Tons	In.
I—7x10.....	50	2	40	1½	25	1	15	¾
II—9x15.....	120	2½	100	2	80	1½	60	1
III—11x18.....	200	3	175	2½	150	2	100	1½

In case I it is seen that a change from 2-in. to 1-in. product gives 0.5 the output; from 1½ to ¾ in., 0.37 the output. In case II, a change from 2 in. to 1 in. gives 0.62 of the output. In case III, a change from 3 in. to 1½ in. gives five-tenths (0.5) the output.

There is no consistency in the table, the intermediate size showing less cut than the one larger and the one smaller. The table is in all probability no more than a guess.

The Rennerfelt Electric Furnace

A type of electric furnace that is making great progress in Sweden, Norway and Russia is the Rennerfelt,

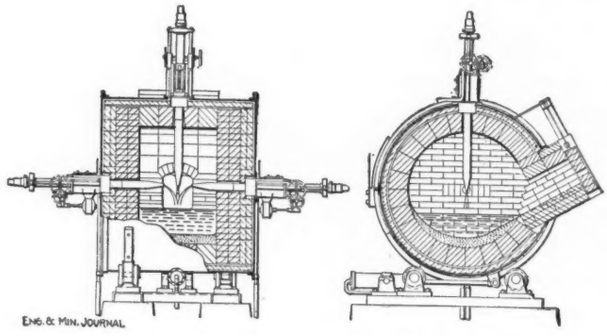


FIG. 1. ARRANGEMENT OF ELECTRODES

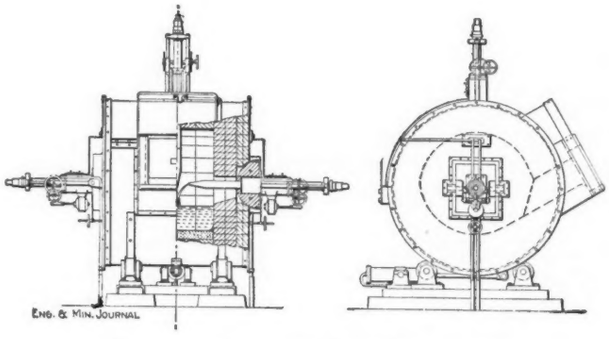


FIG. 2. SIDE AND END ELEVATION

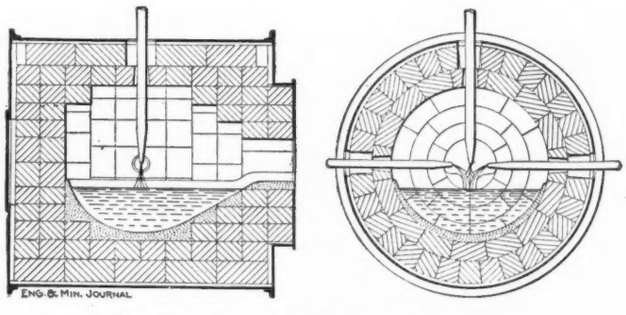


FIG. 3. MODIFIED FORM OF FURNACE

which is an economical small furnace for crucible works, steel foundries, copper, alloys and chemical processes requiring high temperatures. The principle is applicable to small units of 100 kg. as well as to larger sizes, and it is claimed that it may be applied to the really large steel

furnaces of 50 tons or even more. It is due to Ivar Rennerfelt, a Swedish engineer who in 1912 constructed at Hallstahammar, in Sweden, a type of furnace which operated so successfully that within a year a steel foundry containing four of them was erected, and up to January, 1914, 15 furnaces ranging in size from 300 kg. to 3 tons capacity were put into operation or ordered in various parts of Europe.

The construction of the Rennerfelt furnace may be studied by reference to Figs. 1, 2 and 3. It is preferably built with a horizontal cylindrical steel shell rolling in cradles or tilted round the horizontal diametrical axis. The furnace is lined with silica, coke or magnesite brick, according to the work for which it is intended, and a closely fitting charging and casting door is placed in one side or at each end of the furnace. The current is admitted by three electrodes. One central electrode descends vertically from the crown of the roof, and on each side of it is a horizontal electrode entering through the sides of the furnace. In Fig. 1 will be seen an arrangement of electrodes with the side electrodes sliding in fixed holders, but adjustable axially by hand or power. In the cross-section of the furnace in the same figure will be seen the charging and casting door placed in the circular wall. Fig. 2 shows the furnace in side and end elevation. Electrodes adjustable vertically are preferably used where the furnace is employed for melting light scrap requiring considerable space below the arcs before it is melted. This arrangement allows the operator to run the furnace with free-burning arcs independent of the volume of the charge, or with arcs in contact with the metal if it is required to use the method of heating employed in the types of arc furnaces previously constructed. A modified form of the furnace is shown in Fig. 3. Here the charging door is at one end and the horizontal electrodes are placed on the shell in the position shown by the transverse section. In ordinary practice, the electrodes do not come into contact with the slag or steel, the arcs being free burning and ensuring smooth working when melting cold scrap. This has always been a difficult operation, especially if the furnace is supplied from a small power plant.

Three-phase current of any voltage or frequency is passed into a transformer arranged for Scott's methods of phase transformation, changing the energy into a balanced two-phase current delivering single-phase current to each of the horizontal electrodes, a return cable connecting the common points of the two phases with the central electrode. Where possible, of course, two-phase current can be directly used. The currents entering through the horizontal electrodes neutralize one another, but the action of the returning current into the central electrode generates a field of force deflecting the arcs into an inverted arrow-head. This form of arc is one of the reasons for the success of the Rennerfelt furnace, as the heat generated in the arcs is more concentrated down upon the bath, although the electrodes do not touch or even approach the slag or metal. The arcs sweep or brush all over the central spaces underneath the points of the electrodes, heating the charge uniformly and rendering the slag fluid and chemically active. The height of the arcs from the point of the electrodes to the surface of the bath can be adjusted, but is usually kept from 6 to 12 in. Smaller furnaces are tilted and discharged by hand lever and a ratchet movement, while larger ones are operated by power.

This furnace is really a large internally heated crucible capable of being charged either with cold or liquid metal. If the former, the metal is charged into the preheated furnace either with or without flux, and during the charging, in order to prevent injury of the electrodes, the latter can be drawn back or raised. When charged the electrodes are adjusted to their proper position, the door closed and current turned on. The cold charge chills the furnace considerably and therefore a good deal more power is used at the start, this being gradually reduced as the brickwork is heated to avoid injury to the lining by overheating. Rapid melting takes place, the metal being covered by an unbroken sheet of slag, protecting it against any oxygen in the furnace. As a rule, however, the atmosphere is either neutral or strongly reducing, since it is charged with carbon monoxide. As the door is closed outside, air is not admitted during operation until the charge is ready for testing. Samples of the steel are then taken and alloys added as may be required. Lime, slag, sand or fluorspar, together or separately, are added, fused and skimmed off, absorbing practically all phosphorus and sulphur. The number of slag renewals depends on the quality of the raw material and the results required. When the heat is ready, it is poured, this being at a temperature much higher than is obtained in an openhearth furnace, so that the steel has often to be cooled in the ladle to a temperature at which it can be cast without burning the molds or spoiling the castings. Perfect deoxidation is then easily obtained, and hence splendid castings or ingots free from blow-holes or piping are obtained. After tapping the heat, the bottom and slag line are fettled, if necessary, with ground dolomite or ganister, the fettling is sintered by turning on the power, and a new heat is charged. For an output of 20 or 30 tons per day of 24 hr., one melter and two laborers per shift are required.

In the strongly braced steel shell is an insulating lining of asbestos board; either silica or first-quality firebricks in rings are built up against the board forming the bedding for the actual acid or basic lining, which is made of special bricks set in rings of different diameters, forming an egg-shaped interior melting chamber. The bullseye round the charging door is fitted into the lining, and where the electrodes enter, special bricks are provided to form circular openings. The furnace with basic roof and hearth has run 102 heats on cold charge without needing any repairs beyond the ordinary fettling, and a furnace with acid roof and lining, operated continually day and night for 2½ months on cold scrap for acid tool-steel, ran not less than 174 heats. The temperature in the basic was kept considerably higher than in the acid furnace. Although the radiating heat from the arcs is reflected on to the bath from the entire incandescent inner surface of the vault, the arcs are at such a distance from the roof that the danger of melting it is minimized, and the shadow of the vertical electrode has a protecting influence on the portion round the entrance opening for the electrode, which is a most vulnerable point.

The roof, side walls, and bottom are all built together in one continuous curve. The arch is strong, and the effects of expansion and contraction of the lining are much reduced. The furnace is small compared to its capacity, and to facilitate relining, the cylindrical shell

is divided into an upper and lower half, bolted together after lining. The electrodes are held with a loose fit in water-cooled insulated phosphor bronze or copper boxes or holders, those for the horizontal electrodes being preferably adjustable in the vertical plane. The power cables are attached to the electrode holders, current being transmitted by means of sliding contacts or brushes. For a 600-kg. furnace the electrodes measure 2 in. in diameter, and for a 2-ton furnace 3 and 4 in. They are Acheson graphite electrodes, that is, of amorphous carbon, electrically converted into graphite. The electrodes are turned to diameter and made continuous by threaded sockets and dowels, the new section of electrode being screwed on to the section at work. For smaller furnaces the electrodes, which can be touched without shock, are fed by hand, while in the larger furnaces automatic feeding is used. In a 600-kg. furnace running continuously on charges of cold scrap and pig, the average electrode consumption is about 2.8 kg. per ton of steel. Even when melting pig iron and afterwards decarbonizing it by means of ore, the consumption of electrodes has not ex-

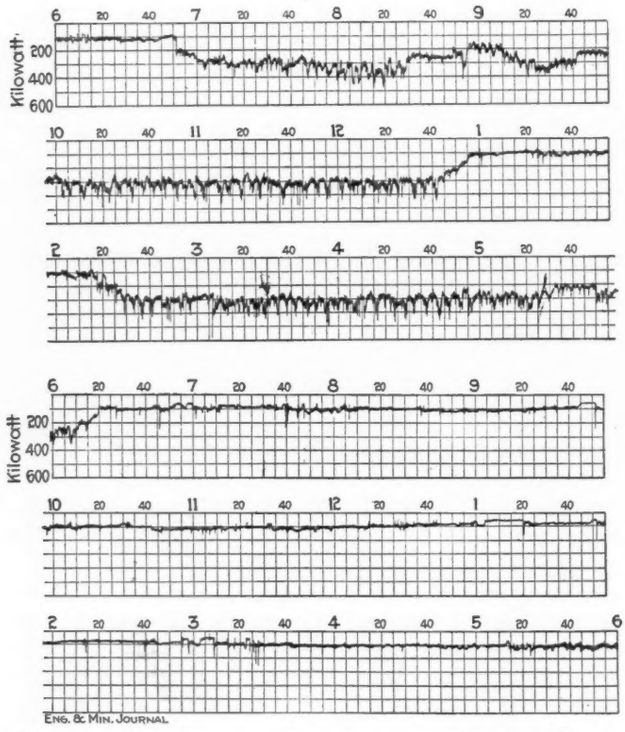


FIG. 4. PERFORMANCE CURVES WITH FURNACE RUNNING ON TOOL STEEL

ceeded 3 kg. per ton of steel in spite of the highly oxidized slag carried on the charge. The wear of the side electrodes in a small furnace with acid lining using side electrodes of 2-in. diameter, amounts to about 1 in. of electrode per hour. Three such electrodes being used, the wear of the electrodes in 24 hr. equals about 6 kg. With the furnace at full power, five heats of 600 kg., or three tons of steel, are produced per 24 hr., making a consumption of electrodes of two kilograms per ton.

Fig. 4 shows curves of the performance of the furnace when melting cold scrap obtained from a 600-kg. furnace running on tool steel at Trollhättan. The furnace is normally rated at 125 kw. but only about 100 kw. are required. It runs night and day on cold charges, drawing power from an adjacent government power plant. Certain portions of the curve are affected by the operation of some rolling mills, causing strong fluctuations in the power curve in spite of heavy flywheels. The curve is rather peaky when the rolling mills are on, but comes down almost to a straight line at night and noon, when the furnace alone is working. The peaks of the furnace are comparatively low and rarely exceed 50% of normal load. The 1¼-ton furnace is rated at 200 kw. and is operated without automatic regulators or similar protective apparatus, receiving the surplus energy from a hydro-electric power plant of about 800 hp. capacity. An ordinary oil switch with time relays is used to give sufficient protection to the generators, a circuit-breaker being set to work at 400 kw., or double normal furnace load. The furnace works like a large inclosed arc lamp practically without any disturbing influence from the charge underneath the arcs. As regards phase displacement, in one instance $\cos \phi = 0.97$, with a furnace operating with a current of 50 periods. With regard to efficiency, a small furnace of 600 kg. at the Ljusne Iron Works melts and refines a full charge of cold scrap with not more than 700 kw.-hr. per ton. The normal rating of a furnace of this capacity is 125 kw., but according to records 80 to 90 kw. are enough to complete a 600-kg. heat in five hours. This gives a satisfactory thermal efficiency even when running with only 75% of full load. White pig iron has been melted in the same furnace under similar conditions with 405 kw.-hr. per ton. In one instance, gray pig iron was melted and overheated with 425 kw.-hr. per ton including the melting of 22 kg. of basic slag per ton of iron, indicating a furnace efficiency of about 70%. Under very favorable conditions, it has been found possible to melt gray pig iron with about 300 kw.-hr. per ton in a 600-kg. furnace, equal to a thermal efficiency of 85 to 90%. This high figure for such a small furnace can be explained by noting that the efficiency of the electric furnace is greater at lower than at the higher temperatures required for refining steel. If pig iron is rapidly melted in a high-power furnace designed for melting steel, the furnace efficiency shows a marked increase on account of the shape and position of the arcs. Owing to the circular form of the vault and the thermal insulation used, the Rennerfelt furnace is particularly suited for rapid melting with a minimum loss and it constitutes an important contribution to the apparatus applicable to electrometallurgical work. We are indebted for the above information to the Aktiebolaget Elektriska Ugnar, of Stockholm, Sweden, which has successfully developed this new type of furnace.

Forfeiture of Mining Claims

BY A. L. H. STREET*

The rule that where the locator of a mining claim fails to perform required assessment work during a year, he cannot by afterwards doing it restore his rights, where in the meantime the claim has been relocated by another person, was applied the other day by the Arizona Supreme Court in the case of McDonald vs. McDonald, 144 *Pacific Reporter* 950. In this case it was held that claims became forfeited midnight, Dec. 31, where work for the preceding year was not done until Jan. 16 following, and in the interim defendants had made a relocation.

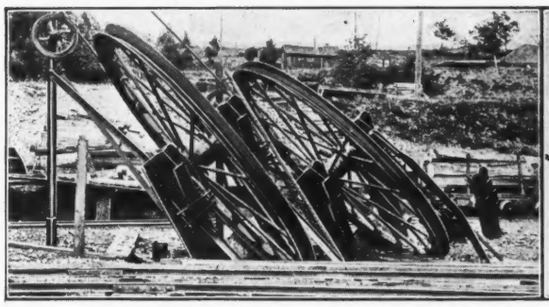
*P. O. box 112, St. Paul, Minn.

Design of Angle-Sheave Frames--II

By Floyd L. Burr*

SYNOPSIS—Examples of recent construction at the Penn shafts. At a West Vulcan shaft a double turn required one type-1 and one type-2 frame. Ropes passed through old dump in discarded steel stacks as conduits. Old frames had to be kept in service while construction proceeded and the old ropes were carried through holes cored in the new concrete piers. At Curry shaft a type-1 frame carries sheaves high in the air. At the East Vulcan a type-4 frame entirely of concrete has just been completed; unusual method of establshing the position of the members.

A recent installation at "C" shaft of the West Vulcan mine gives an illustration of angle-sheave frames of type 1, following the classification presented in the first installment of this article, and also of type 2. The hoisting ropes emerging from the hoist house travel about 80 yd. toward the east, thence a similar distance to the north to a point near the base of the headframe and thence in a westerly direction to the headsheaves. There are the cage rope and the skip rope to care for at present; and it was necessary to make provision for a skip-balance rope and a cage-balance rope which may be installed at some future time.



West Vulcan C Shaft Type-1 Frame

Looking northeast. Ropes shown rising to headframe, guided by pulleys on boiler-tube mast.

Guyed Boiler-Flue Mast for Idler Pulleys

West Vulcan C Shaft Frame

Looking northwest. Frame at right provided for a future 6-ft. skip-balance sheave.

In their travel to the east and north, the ropes run extremely flat, while in rising to the west toward the headsheaves they are steep. The conditions thus called for a type-2 frame for the first turn, that nearest the hoist, and a type-1 frame for the second. These new frames were to replace old decayed wooden structures and had to be built and made ready for use before disturbing the old ones. It was also necessary so to arrange that there should be no interference with the run of the ropes into the old structures and in the case of the type-2 new structure these ropes had to run through the frame—indeed, through holes cored in one of the concrete piers. These conditions fixed rather closely the positions of the intersection points, the exact positions horizontal and vertical being chosen arbitrarily.

Type-1 Angle-Sheave Frame at the West Vulcan

Type-1 structure consists of a concrete base with its top flush with the ground surface, from which emerge three steel frames. Each frame is to support a sheave, one each for the cage, the skip, and the skip balance. A separate structure will be built in case the future demands a cage balance. Each frame consists of a pair of steel members crossbraced together rigidly below the open space occupied by the sheave and provided with crosspieces at the lower end for anchorage into the concrete. The concrete base slab is about 7 ft. deep; the steel members reach nearly to the bottom and extend above the concrete to a point just above the bearings of the sheave wheel. The balance-rope sheave not yet installed will be 6 ft. in diameter while the others, which are in service, are 10 ft. The intersection points were placed at an elevation about flush with the ground level. Each member is made up of an I-beam with a channel riveted to its upper flange, giving stiffness in two planes. The bearings for the sheave rest upon the upper flange, or channel web, and are attached by bolts which reach through the bottom flange. Angle-steel braces are attached to these members near their upper ends and reaching down to auxiliary anchorage piers help to stay the main members against the bending stresses which occur by reason of the eccentricity of the position of the center of the sheave. This placing of the bearings on one flange of the members is not a thoroughly satisfactory detail and in future installations an attempt at improvement will be made. The center of the sheave and the resultant should coincide with the plane of the center lines of the members, and thus do away with practically all bending moment.

The concrete base was proportioned so that the portion contiguous to each frame should be heavy enough to resist the tendency to lift, corresponding to the vertical component of the resultant. The rope stress considered was the breaking load of a 1¼-in. "extra-strong cast-steel" rope. The steel frames are designed to withstand the stresses arising from the same load.

Of course, a set of computations was made for each sheave to determine the quantities ϕ and θ for that particular sheave. Each of the three frames was thus a problem by itself for computation and erection. In the designing of the layout it was necessary to make sure that there should be no interference between any two wheels, their frames or their ropes.

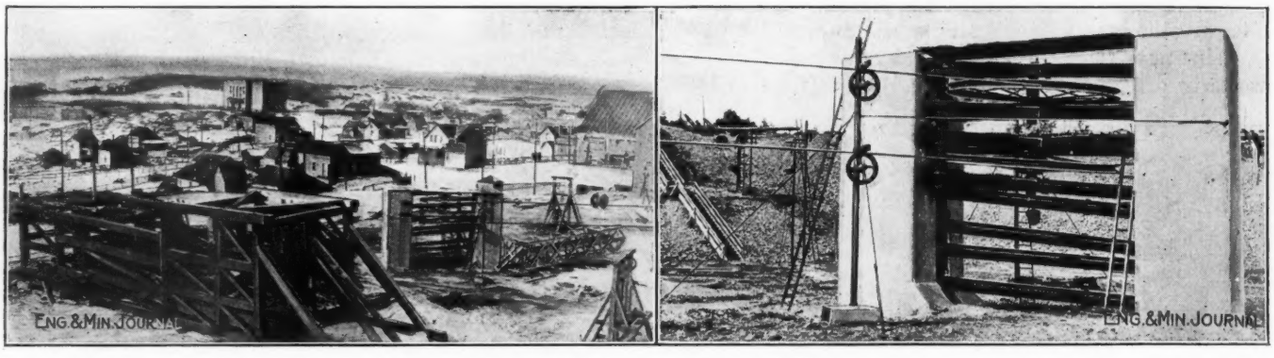
The concrete base being all below the ground level. the

*Structural engineer, Penn Iron Mining Co., Vulcan, Mich.

placing of the concrete was exceedingly simple. The mixer was set up at one edge of the excavation and after the steel members had been placed in proper position the concrete was merely poured direct from the mixer into the forms—the excavation was in an old rock fill and would not stand without form work. About 75 cu.yd. of concrete was consumed. Considerable irregular reinforcement was placed in the concrete with the idea of binding it together to act as one mass and suspend it from the steelwork. This reinforcement consisted of old steel rope 1⅛ in. or 1¼ in. in size. A force of nine men spent one and one-half days at the work of actual concreting. The mixer used was a skip-loading No. 11 Cube machine, operated through gearing by an electric motor.

The ropes approaching these sheave wheels from a lower elevation had to run under the surface of the ground for about 35 ft. from their intersection with the slope of the hill.

The elevation of the intersection points was purposely fixed so that the ropes would enter below the surface in order to pass under the rock and ore tramway tracks. It was not practicable to build concrete tunnels or conduits for the ropes on account of their position about 15 ft. above and directly over an old tunnel through which the old ropes entered the deep pit containing the old angle sheaves. Therefore it was decided to let the ropes run each through a sleeve or conduit consisting of a length of old discarded 36-in. steel stack. These pieces of stack were suspended from stringers spanning the old tunnel and uncertain ground. After the ropes were put into operation in the new sheaves, the old pit and tunnel were filled with waste mine-rock up to and over the conduits. The extreme depth of the ropes below the surface is about 4 or 5 ft. at the edge of the bank and of course at the point of entering the sheave is nothing.



WEST VULCAN "C" SHAFT TYPE-2 FRAME

Looking southwest, showing relation between old wood frame and new concrete frame. Note wood concreting tower lying on ground; holes in concrete piers for old ropes; and old wood pulley stands.

Note idler-pulley masts in foreground; steel-stack conduits and type-1 frame in background.

TYPE-2 STRUCTURE AT WEST VULCAN

Type-2 structure consists of a concrete base 12 ft. wide, 25 ft. long, and 5 ft. deep, surmounted by two concrete piers 16 ft. high by 8 ft. wide by 5 ft. long. The top of the base is flush with the general ground surface. The piers are placed symmetrically with the center lines of the base and there is 12½ ft. clear space between them. The long center line coincides approximately with the lines of the resultants and lies in a northwest-southeast direction. Thus there are the "northwest pier" and the "southeast pier." The sheaves, which are 10 and 6 ft. in diameter, are supported by pairs of steel members located one above another and spanning the distance between the two piers. Provision has been made for four sheaves though there are now only the two main sheaves installed. The supports for the 6-ft. sheaves are only partially installed and will be completed whenever needed.

Tension in the ropes produces compression in the steel members which push against the northwest pier, tending to bend and break it, to tear it off from the base and to tip the whole structure, base and all, over toward the northwest.

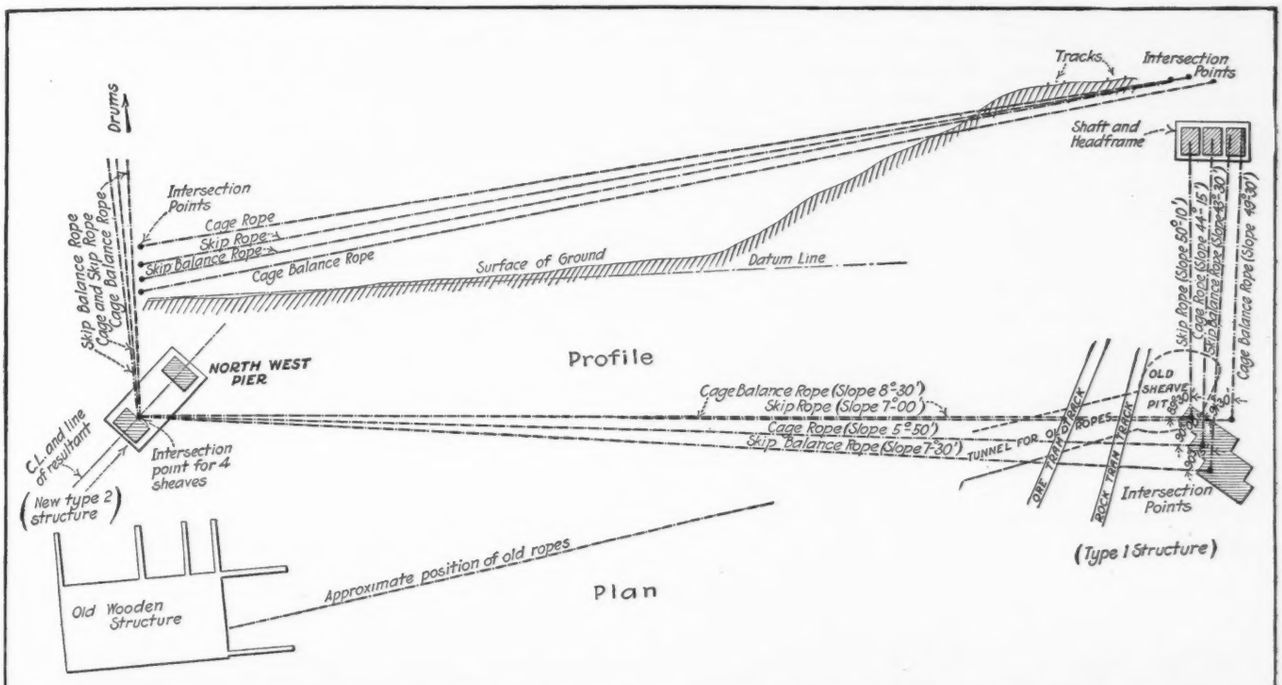
The situation of this structure bears such a relation to the mine workings below that there is a possibility of some settlement. For this reason it was considered necessary to build so that the steel members could upon occasion be removed, rearranged, and put back, in case settlement should occur so as to affect the sheaves more than could be adjusted for by blocking up their bearings. To accomplish this purpose, the steel members are not embedded into the two piers but merely butt against them. They are attached to the piers in such a way as to have their dead weight and that of the sheaves supported. A small space is allowed for the expansion of the steel so as not to put a compressive stress therein nor to put an additional overturning moment or spreading force on the piers.

The northwest pier is calculated as a cantilever from the base slab to safely resist the stressing effects of the breaking of the upper rope while the other three ropes are carrying their working load. The hoisting ropes in use are 1⅛-in., but 1¼-in. ropes were assumed in the computations. The balance ropes were assumed to be ⅞ in.

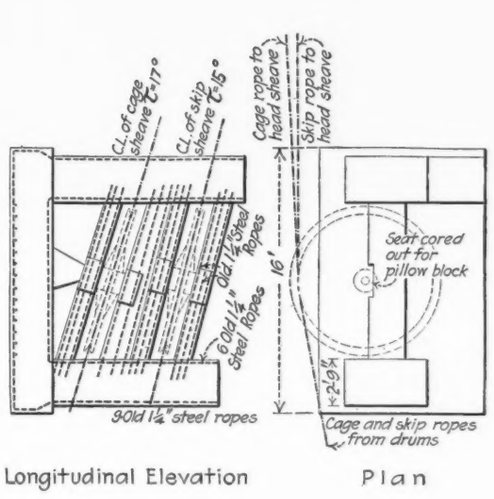
The base slab was reinforced top and bottom to insure its acting as one piece. The northwest pier was reinforced as a cantilever, the reinforcement being continuous with that in the base. This reinforcement consists of discarded 1⅛-in. and 1¼-in. steel ropes. These ropes were used rather lavishly. It was found convenient to let them run up into the southeast pier much as in the northwest pier, so that it is actually reinforced, though there is no definite requirement for such reinforcement. The function of this southeast pier is to furnish weight for stability of the whole structure and to support the dead weight of the steel frames and their sheaves. It also serves to resist its share of any incidental lateral stresses.

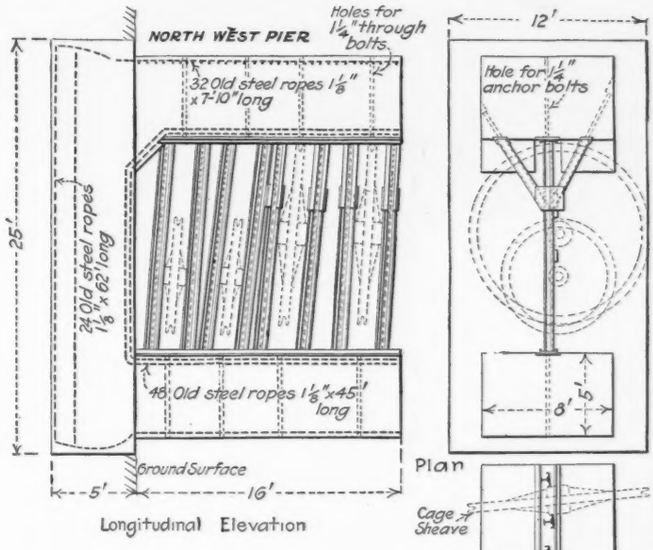
METHOD OF CONSTRUCTION

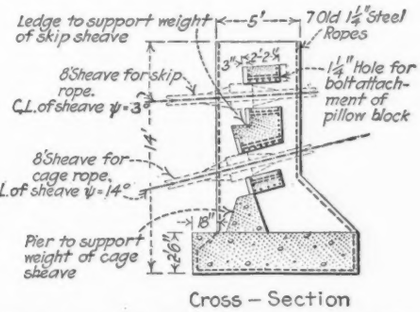
The pit for the base having been excavated and forms for the piers erected, a series of long ropes were laid



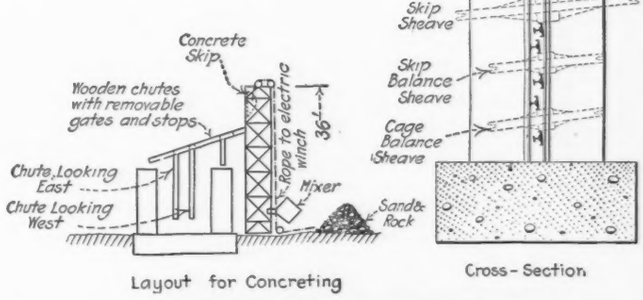
LAYOUT OF ANGLE-SHEAVES AT "C" SHAFT, WEST VULCAN MINE.






Ledge to support weight of Skip sheave
5'
7 Old 1¼" Steel Ropes
8' Sheave for skip rope. C.L. of sheave ψ = 3°
1¼" Hole for bolt attachment of pillow block
14'
8' Sheave for cage rope. C.L. of sheave ψ = 14°
Pier to support weight of cage sheave
18"
2'-6"
Cross – Section

CONCRETE ANGLE-SHEAVE FRAME AT EAST VULCAN MINE.

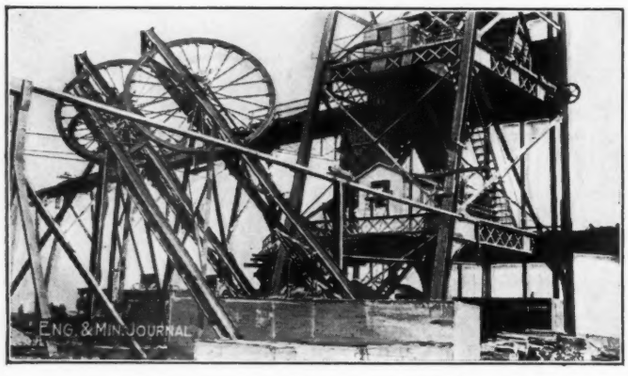


CONCRETE AND STEEL ANGLE-SHEAVE FRAME AT WEST VULCAN MINE.

SOME OF THE PENN IRON MINING CO.'S ANGLE-SHEAVE FRAMES

in a longitudinal direction in the bottom, then about 18 in. of concrete was placed embedding the ropes about 2 or 3 in. from the bottom. Also at each end, there were embedded certain anchorages made of old rails. These supported horizontal rails at the inside points of junction between the piers and the base. They were to serve a little later to take the strain arising from tightening the inside face ropes.

The ends of the long ropes, the middle portions of which were now embedded in the 18 in. of concrete, were picked up and some of them drawn up tightly into the pier forms near their outside faces. Their upper ends were wired to strong wooden beams which had been supported by bents over the forms. The rest of these ends were laid back on top of the 18 in. of the concrete, to be embedded into the bottom of the remaining 3½ ft. of base. It should be mentioned that in casting this 18 in. of base, scrap rails and rods were embedded vertically here and there to bond to it the remaining portion of the base.



THE HIGH TYPE-1 FRAME AT THE CURRY SHAFT

The other series of ropes was now put in place. These followed down the inside face of one pier form, then behind the anchorage bar mentioned above, thence horizontally across the intervening 12½ ft. to the other pier at an elevation a few inches below the top surface of the base slab, thence behind similar anchorage bars and up into the other pier form near its inner face. This latter series is of the greatest importance, since it provides the cantilever reinforcement of the northwest pier. The ends of these ropes were wired to overhead wooden beams after the ropes had been well tightened by use of the tackle. Concrete was then poured to complete the base and the piers.

The pier forms were of rough planks but were lined with tarred felt both as a nonfreezing precaution and to make the forms watertight. Concrete was mixed in proportions varying from 1:2:4 to 1:3:5.

The concreting plant consisted of a No. 11 Cube mixer with loading skip, stockpiles of sand and rock on the ground in the immediate vicinity, a 36-ft. wooden elevator tower containing a self-dumping bucket into which the mixer would discharge directly, an inclined wooden trough or chute with branches above the forms, and an electric hoist for operating the bucket elevator. This plant worked smoothly. A force of 10 men was required to mix and place the concrete. One full and two fractional days were consumed in the concreting. The concrete amounted to 104 cu.yd.

Removable steel platforms, head guards and ladders give access to the sheave bearings for oiling purposes, etc. On account of the profile of the ground, the cage and skip ropes between the two frames and to the west of them, are at an elevation of from 10 to 25 ft. above the ground. They are supported by idler-pulley frames of the guyed discarded boiler-flue mast type described in the JOURNAL of Feb. 21, 1914, as used at the Republic mine.

TYPE-1 FRAME AT THE CURRY SHAFT

Another example of a type-1 angle-sheave frame exists at the Curry shaft of the Penn mines. This consists of three steel frames, the lower ends of which are embedded into a concrete base, part of which is below the surface and part of which extends about 7 ft. above the surface. Two of these frames carry 12-ft. sheaves for cage and skip ropes, while the other frame carries a 6-ft. sheave for the skip-balance rope. The structure is situated at a point about 35 ft. north of the foot of the backstays of the steel headframe. Just north of the structure, there is the main county road over which the ropes must pass at a sufficiently high elevation to clear traffic. This latter condition fixed the elevation of the intersection points at 17 ft. above the ground, and produced a rather high structure.

The main steel members are given lateral support at points in the region of the sheave bearing by irregularly placed angle-steel braces or stays reaching down to small auxiliary piers.

The steelwork was erected during 25°-below-zero weather in February, 1912. The adjustment of the frames with such temperatures prevailing was a rather disagreeable task. The concrete was cast soon after, using steam-heated sand and rock, and was mixed as follows: Wooden platforms of large area were laid on the ground and upon these platforms was constructed a steam coil of 1¼-in. pipe and return bends. Upon this there was heaped 3 to 5 ft. of rock or sand. Over the top was put a layer of straw. Steam was taken from a large main then existing to supply the old Curry steam hoist, and in a few days after turning it on, the whole mass was hot. Mixed concrete went into the forms at a temperature of about 70° F.

TYPE-4 STRUCTURE AT EAST VULCAN

An example of a type-4 structure is furnished by a design now in process of erection at East Vulcan No. 4 shaft. This is to carry two 8-ft. sheaves for the cage and skip ropes. The horizontal angle between the ropes lacking only 8° or 10° of 180°, the intensity of the resultant stress is comparatively slight. The structure is designed to be stable and strong to withstand the effect of breaking one 1¼-in. rope while the other rope is carrying its working load.

This frame consists of a concrete base 2 ft. 6 in. thick and 10x16 ft. horizontal dimensions, surmounted at each end by piers 2 ft. 9 in. long and 5 ft. wide. The north pier is 11 ft. 6 in. high, while the south pier is 10 ft. high.

Framed between the piers and cast integrally with them are reinforced-concrete beams which are to support the weight of the sheaves (a vertical load) and resist the lateral force of the rope-stress resultant. The resultant tends to bend them toward the east and through the medium of these beams to overturn the piers and indeed

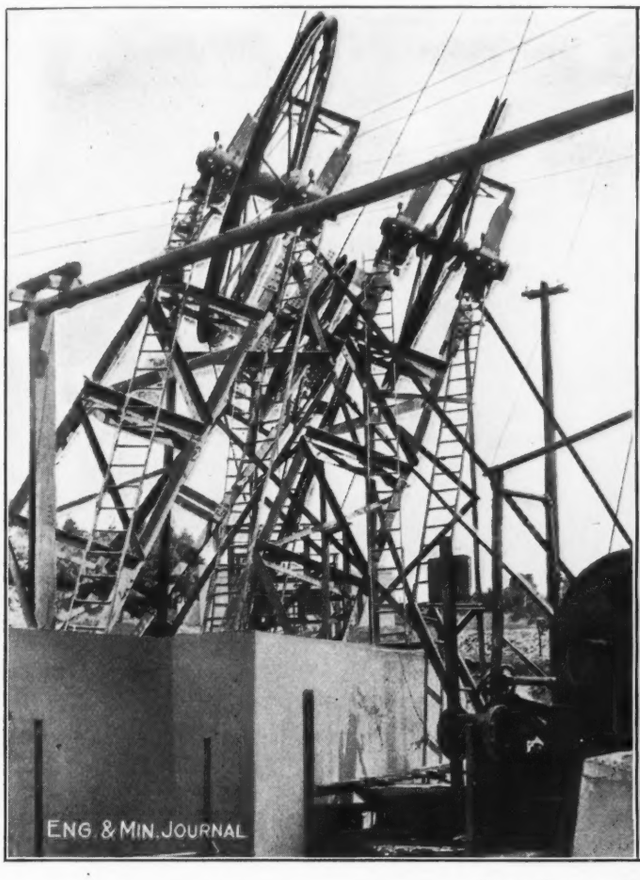
the whole structure in the same direction. There is also a small end thrust exerted.

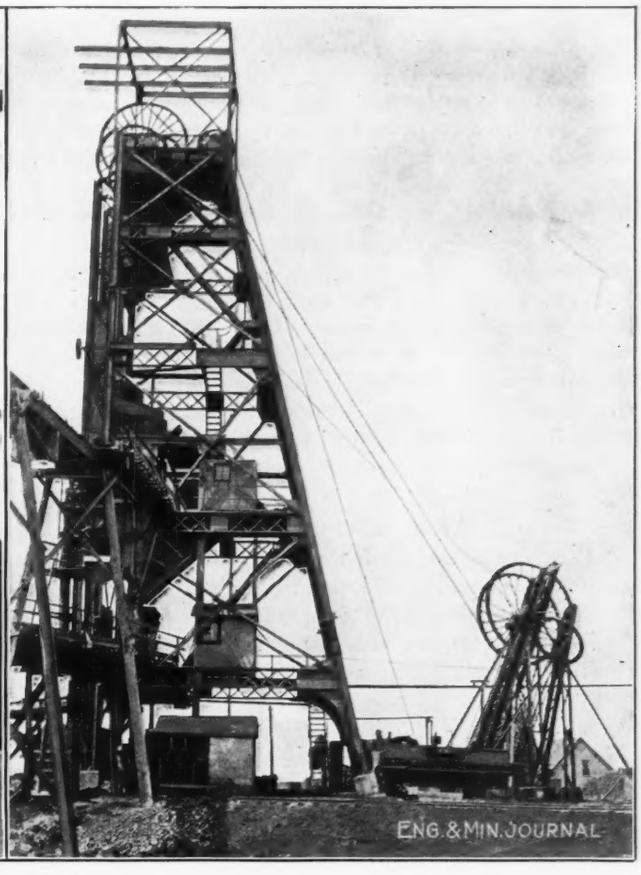
Old steel ropes are placed as reinforcement to cause the base to act as one piece and to bind the piers firmly to it. The concrete is a rubble mixture 1:3:5. About 31 cu.yd. is required.

Certain conditions not necessary to mention, fixed the position of the structure and limited the width of the piers.

The structure is set with its transverse center line at angles of some 5° or 10° from the lines of resultant of the cage and the skip ropes. The values of ϕ and θ were computed and used for the approximate design of the structure. For the exact setting of the beam forms, however, a mechanical scheme was used. This worked nicely for this case but would not be convenient for use in general.

The intersection points, which are on the west side of the structure, were located and marked in space by the heads of nails driven into suitable wooden falsework. It was possible to see easily from these points to points where the ropes would enter the headsheaves and to the drums.

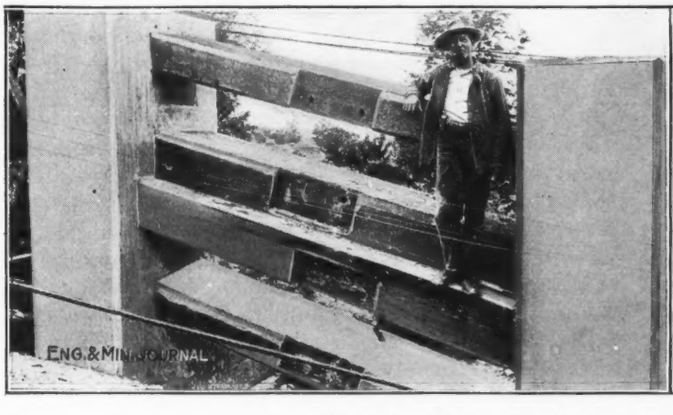




THE CURRY FRAME—TYPE 1

Looking northeast. Showing heavy concrete base.

Looking west, showing relation between headframe and angle-sheave frame.



TYPE 4. CONCRETE FRAME AT EAST VULCAN NO. 4 SHAFT

Left view looking east showing recesses for sheave bearings. Right view looking northwest. Forms just removed. Note boltholes for attachment of sheave bearings. The trestle supports a temporary runway over which concrete was wheeled in concrete carts.

Other nails were sighted in along these lines at distances of 15 ft. or so from the intersection points. A suitable wire was stretched along these lines, which were, of course, the future paths of the ropes. Then on the east side of the structure, the transit was "jiggled" into line between the same points at headsheave and drum and lines were stretched to correspond. Thus for each sheave wheel we had three lines which determined the plane of the sheave, the alpha-beta plane. Now by sighting across these lines from east to west, strips were accurately located and aligned at angle ψ on the pier forms for the support of the beam forms. The longitudinal slope of the beams, angle τ, is about 17° for the cage sheave and 15° for the skip while the transverse slope, angle ψ is about 14° and 3° respectively.

It is my own opinion that the best material for beams for structures of types 2, 3 or 4 is reinforced concrete, since it can be so easily molded to any desired detail for support of sheave bearings and can be used equally as well for strut-beams as for beams subjected to bending only. It is also probably more economical than steel when used in connection with concrete piers.

Utah Copper Co.

The report of the Utah Copper Co. for the last quarter of 1914 shows a production of 20,229,012 lb.: 6,765,396 lb. in October, 6,668,049 lb. in November and 6,795,567 lb. in December. Comparison of this quarter with the preceding one is shown in the accompanying table:

	Fourth Quarter, 1914	Third Quarter, 1914
Production, lb.	20,292,012	26,686,672
Av. mo. prod., lb.	6,743,004	9,562,224
Net profit	$673,591	$1,286,323
Other income from rents, etc., Utah	27,296	26,415
Inc. from Nev. Cons. div.	375,187	.....
Total net profit	$1,076,074	$1,312,738
Dividends paid	1,218,367	1,218,367
Deficit	$142,293	*$94,371

*Surplus.

Ore milled during quarter was 1,035,303 tons, as compared with 1,466,606 tons for the previous quarter. Assay of the ore was 1.5062% copper, compared with 1.4356% for previous quarter. Extraction was only 64.86%, as compared with 68.13% for the third quarter of the year. This unusually low extraction was due to the fact that the ore treated contained a considerable portion of its values in the form of carbonates of copper.

The earnings for the quarter are on the basis of 11.236c. per lb. for copper as against a basis of 12.480c. per lb. in the previous quarter and 14.857c. per lb. in the quarter ended Dec. 31, 1913. The reason for this low valuation is due to the desire on the part of the management to have all unsold copper at the end of the year carried at its then market value, and was occasioned by the fact that at the time of the curtailments in August the company was carrying a large amount of unsold copper, a considerable amount of which was sold at a substantial reduction from the price from which it was then carried. Furthermore many sales previously made for foreign delivery in August and September were canceled. The total amount of copper on hand and in transit, sold and unsold, at the end of the quarter was 40,546,627 lb., as compared with 50,118,797 lb. at the end of the third quarter. The unsold portion of the copper on hand and in transit was inventoried at 13.50c. per lb., the prevailing market price at the time, and the same price at which it was carried at the beginning of the year.

The average cost per pound of net copper produced during the quarter, after making allowance for smelter deductions, and without crediting miscellaneous income, was 7.731c., as compared with 7.760c. in the third quarter. If the miscellaneous earnings in Utah, including those of the Bingham & Garfield Ry., were credited to the cost of operations the net cost for the quarter would be 6.688c. per lb. The earnings of the railway company available for such credit were increased on account of that company not having to pay interest on nearly $2,000,000 of its bonds, which were retired near the end of the second quarter of last year. The cost shown is satisfactory, when the fact that operations were conducted on a half-capacity basis for the entire quarter is taken into consideration.

In addition to the amounts shown above, there was received from the Bingham & Garfield Ry. Co. a stock dividend amounting to $1,505,500, representing past earnings applied to capital expenditure. As the bonds of the railway company now have all been retired except $25,500, its earnings will from now on be added to the earnings of the Utah Copper.

The business of the Bingham & Garfield Ry. during the quarter was satisfactory considering the enforced curtailment in its operation. An average of 7611 tons of ore per day was transported, and an average of 2187 tons per day of other freight, making a total of 9798 tons per day.

Nevada Consolidated Copper Co.

The report of the Nevada Consolidated Copper Co. for the last quarter of 1914 shows a production of 8,065,236 lb. of copper: 2,801,507 lb. in October, 2,612,071 lb. in November, and 2,651,658 lb. in December. The property was operated at 50% of normal capacity.

During the quarter 416,825 tons of Nevada Con. ore, containing 1.54% copper, was milled. 98% of the tonnage came from the pits and 2% from the underground workings of the Veteran mine, and 677 tons of Giroux Con. ore was milled during the quarter.

Cost of copper produced, including Steptoe plant depreciation and all charges except ore extinguishment, and after crediting all miscellaneous earnings was 8.42c. per lb. Earnings are based on copper at 11.504c. per lb. Copper on hand and in transit, sold and unsold, at the end of the quarter was 22,378,133 lb. Unsold copper was inventoried at 13.5c. per pound.

After payment of the twentieth dividend, there was a deficit of $378,949. There was set aside $76,592 for plant and equipment depreciation, and $40,460 for ore extinguishment, making a net charge to undivided profits for the quarter of $496,000.

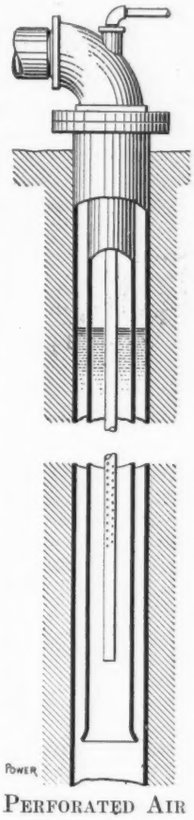
Nevada Northern Ry. Co. purchased from the Nevada Con., for the investment of its sinking fund, $125,000 par value of the railway company's bonds held by the copper company and the investment account is correspondingly decreased.

New Zealand Mineral Production in 1913 has been officially reported, the principal items being as follows: Gold, 343,595 fine oz.; silver, 975,616 fine oz.; scheelite, 221 long tons; coal, 1,888,005 long tons; kauri gum, 8780 long tons. The value of the whole mineral production in 1913 was £3,079,663.

Details of Practical Mining

Preventing Clogging in Air Lift

It is not uncommon in using an air lift, to deliver the air through radial perforations in the air pipe near its bottom. Trouble is sometimes experienced in such cases by the clogging of the perforations with precipitate or scale. E. M. Ivens, writing in *Power,* describes a method of avoiding this difficulty. A section of pipe is added to the line below the perforations, as illustrated, and the lower end left unplugged. Thus any scale or dirt is allowed to escape downward while the air follows the path of least resistance through the perforations. Should the perforations eventually become clogged, the air will still have a path open at the lower end. Its use of this path will allow the lift to operate, but will be detected on the gage. The operator can then clean the pipe when most convenient.



PERFORATED AIR PIPE WITH OPEN END

Length of Drill Steel and Cutting Speed*

The length of the drill steel is an item generally credited as an important influence on drilling speed, and common opinion supports the idea that the cutting speed falls as the length of the steel increases, although some people, on the contrary, feel sure that the long steels drill the fastest. The tests conducted at Franklin do not lend an unqualified support to either view, for the peculiarities of different types of machines play so important a part. For example, if the air feed is strong in a stoping drill the additional counteracting weight of a long and heavy steel may so improve the working conditions as to indicate a superiority for the long steel, and if the air feed is weak the reverse may be true; if the drill steel cuts by virtue of a dancing or "jumper" action, the mass added with length may so reduce its velocity against the rock as to bring it below the amount required for efficient chipping; if the piston normally delivers too heavy a blow for the rock, the drilling speed may be improved by the added inertia of the long steel; and if the steel is always against the rock when a blow is delivered, it is doubtful whether the length of the steel plays an important part unless the permitted decrease in the gage of the drill bits aids the cutting speeds. It is, of course, to be understood that these considerations of drill-steel lengths refer to the performances with bit gages of the same diameter.

*Excerpt from an article entitled "The Testing and Application of Hammer Drills," by Benjamin F. Tillson, presented before the February meeting of the American Institute of Mining Engineers.

Gunite Casing on Wood Shaft Lining

BY STEPHEN ROYCE*

An experiment was recently tried at "A" shaft of the Cary mine, operated by Pickands, Mather & Co. at Hurley, Wis., on the Gogebic range. The experiment consisted of covering the steel sets and wood lath with cement mortar applied with a cement-gun. The shaft

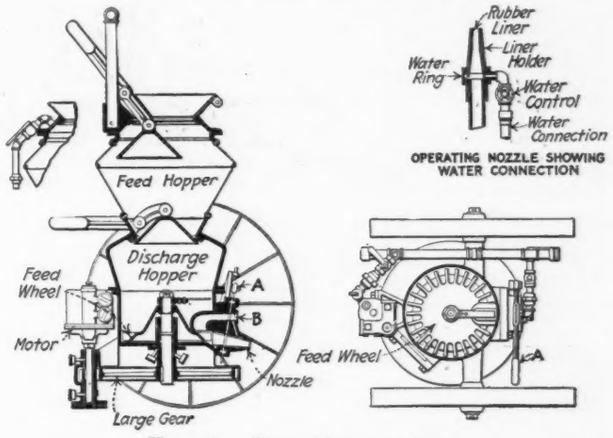


FIG. 1. THE CEMENT-GUN

arrangement is shown in cross-section in Fig. 4. The inclination is 73° 10′. The steel sets are spaced at 4-ft. intervals and the 3-in. hemlock lathing is wedged into the flanges of the I-beams, as shown. The sets were blocked into place by wooden blocking, with bearers put in at intervals of about 50 ft. At the several level openings the shaft was completely concreted before the cement-gun work was contemplated. The total depth of the shaft is 1290 feet.

The hemlock lathing showed signs of rotting out and of course it permitted free circulation of air behind the sets, which it was feared would rot the blocking and so throw the shaft out of line. In order to fireproof the wooden lining, to protect the steel work from rust, to exclude air from the spaces between the sets and the outside rock, and to keep all the wood uniformly wet so as to discourage decay, a coating of 1¼-in. "Gunite," as the material applied by the cement-gun process is called, was decided upon. This has been tried in two experimental sections of the shaft having a total length of 263 ft.

The cement-gun is an apparatus designed to shoot through a nozzle a stream of mixed cement, sand and water in about 4:1 mixture. The apparatus itself (Fig. 1) consists in its principal parts of an upper, or feed hop-

*Mining engineer and geologist, Pickands, Mather & Co., Gogebic range, Hurley, Wis.

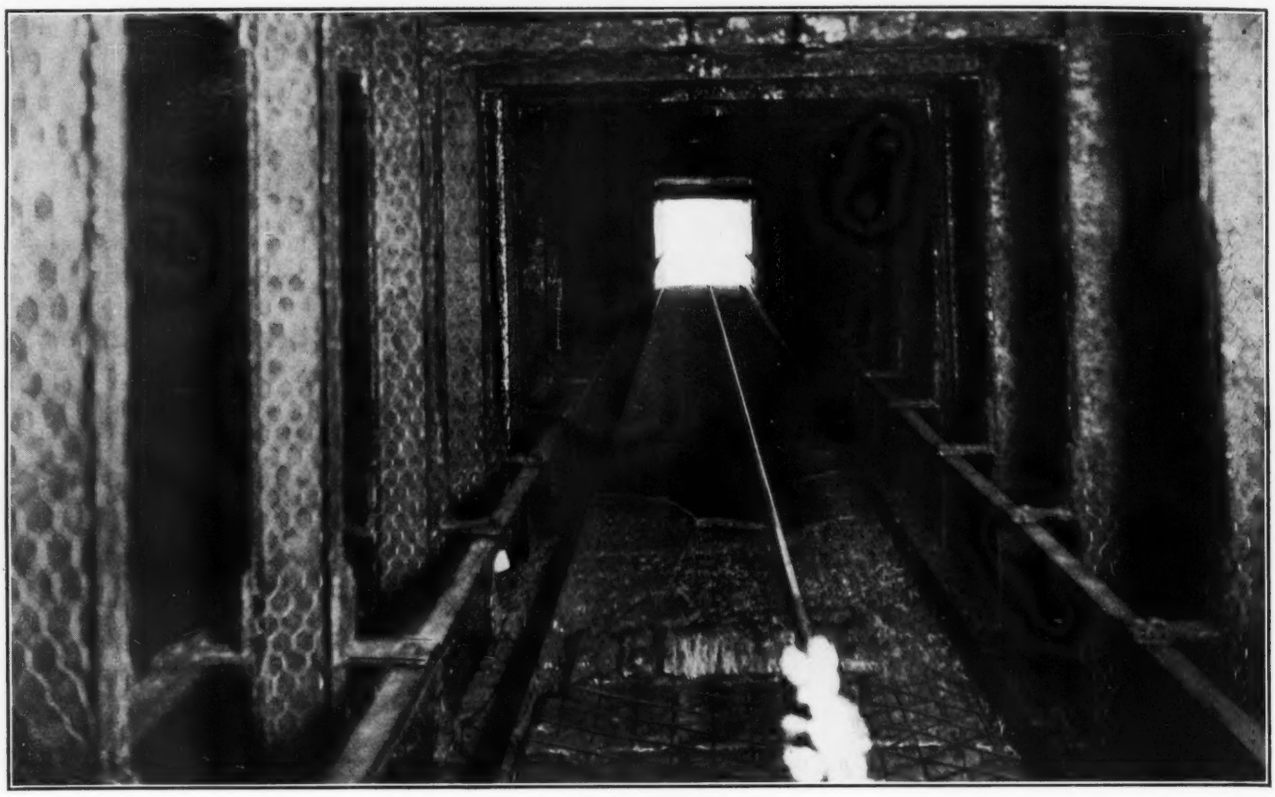


FIG. 2. SKIP COMPARTMENT, SHOWING FINISHED GUNITE, ROUGH LAYER AND UNCOVERED REINFORCEMENT

FIG. 3. THE MACHINE RIGGED AT THE COLLAR OF THE SHAFT

per, a lower, or discharge hopper and a feed wheel which is worked by a motor using compressed air at 45 to 75 lb. The discharge hopper is kept constantly under pressure after the charge has been introduced at the top, and the admission valve has been closed. The cement and sand mixed are charged into the top of the feed hopper with the upper valve open and the lower valve closed as shown. The upper valve is then closed, air pressure is admitted to the feed hopper until the pressure is equalized in the two hoppers, the weight of the cement and sand in the feed hopper presses down the valve and the material drops through into the discharge hopper, on top of the feed wheel.

When all the material in the feed hopper has gone through, the lower valve is closed by means of the lever *A*. The upper valve of the feed hopper is again opened and a new charge is put in. The feed wheel, driven by the motor through a large gear, expels the cement and sand from the lower hopper through the nozzle, which connects by means of the delivery hose with the operating nozzle.

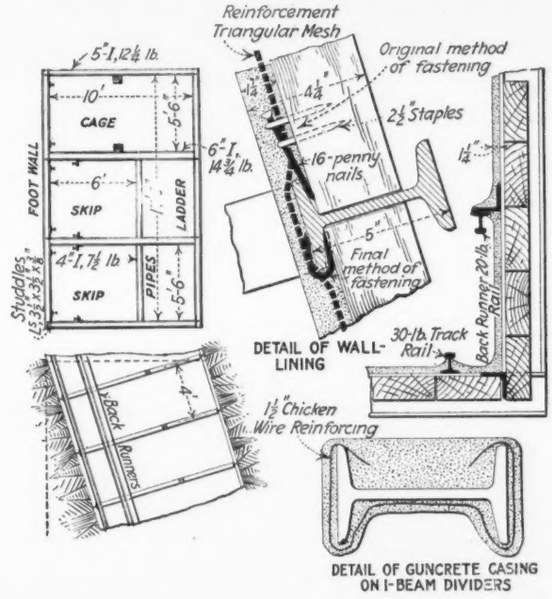


FIG. 4. SHAFT ARRANGEMENT AND DETAILS OF COATED MEMBERS

The feed wheel consists of a series of paddles which form pockets. As these pass the stream of compressed air entering at *B*, they take up measured quantities of compressed air which forces the material through the nozzle and into the hose. The form of the operating nozzle with water connections is also shown. The quantity of water is gaged by the operator; the proportion of cement and sand is gaged in the first mixing. The material as fed into the machine must be dry and no water must reach it before the water control at the operating nozzle. Fig. 3 shows a general view of the machine rigged at the collar of the shaft.

COMPOSITION OF MIXTURE VARIED AUTOMATICALLY

One of the advantages claimed for mortar shot on by this process is that the mixture is automatically enriched where most needed and is less rich where a poorer mixture is sufficient. This results from the tendency of the particles of sand to rebound as soon as they hit a hard surface, so that the first ⅛ or ¼ in. will consist of almost neat cement. This material sets almost as soon as it strikes and the full benefit of the set is given to the work, there being no possibility that the cement may partially set between the time of mixing and the time of applying.

The delivery hose is made of pure soft rubber, covered with heavy canvas and may be as much as 300 ft. or more in length. The wearing out of the delivery hose is one of the chief expenses of operating; one hose may last for a period of time ranging from two to six weeks, according to the character of the sand that is fed.

Of the two sections of shaft covered in this work, one extended from the collar to the 3rd level, the other from the 8th to the 10th level. In the upper section the machine was placed on the surface and the delivery hose was carried down through the shaft to the point where work was being done. In the lower section the machine was set on the 8th level. Material and supplies were handled in a temporary cage in the center compartment, no hoisting being done in the shaft at this time.

DETAILS OF REINFORCEMENT

Like other methods of applying concrete, this method requires reinforcing. In this case the walls were reinforced with No. 7, American Steel & Wire Co. triangular mesh and the dividers with 1½-in. chicken wire, held on with wire clamps. The reinforcement is shown in Fig. 2. Fig. 4 shows two methods of attachment of the reinforcing wire to the steel sets. The first method used nails and staples. This was discarded because it placed too much dependence upon the holding power of the staples in the hemlock plank, which might later decay. The second method depends entirely upon the strength of the staples, which hold directly on the steel, and was adopted for most of the work. The reinforcing wire was also stapled to the laths at intervals between the sets. The dividers were filled in completely on their upper faces, the result being a considerable increase in their ability to resist a downward load. This increase of strength we figure at nearly 20%.

The results seem to have been entirely favorable. There is a solid hard coating of concrete over the entire sides and all the steel work in the shaft. This coating seems to be completely waterproof, so much so in fact that we consider it necessary to set pipes in the bottom of each section coated in order to prevent the water from banking up behind the shaft covering and causing heavy hydrostatic pressure. What the effect will be upon the life of the lathing and of the blocking behind the sets we have, of course, no proof as yet, but from the uniform and apparently airtight character of the coating, we hope that it will greatly increase the life of the wood. If the lathing partially rots, the reinforcement is so solidly fastened to the steel that we believe it will take up a considerable part of the stress now borne by the laths.

Handling Dump-Cars with Derricks in openpit coal mines is one feature of the work of the Central Coal & Coke Co.'s plant near Pittsburg, Kan., says "Engineering News." While the steam shovels are excavating or stripping on one side of the cut, which is 30 ft. deep, coal is being mined on the other side. The coal is loaded into 2-ton tram cars, which are hoisted either by a stiffleg derrick or a revolving derrick, each traveling on a short broad-gage track. The former has a 50-ft. boom and the latter a 60-ft. boom. The cars are taken from and replaced upon a track laid along the top of the cut.

Details of Milling and Smelting

A Note on the Settling of Slimes

By Allan J. Clark*

The accompanying diagrams record determinations of the specific gravity of pulp in clarifying or thickening tanks under certain definite conditions of operation. Whatever interest they may possess lies in the fact that few determinations of this nature have been recorded, rather than in any unusual or unexpected conditions developed by the determinations themselves.

Two types of tanks are illustrated: One a simple hopper-bottomed type, automatic in action and discharge; the other a double-decked arrangement of a shallow Dorr thickener, mechanically discharged, superimposed upon a tank of the first type, which is necessarily modified as to the method of introducing the feed of pulp.

The samples were taken partly through a tube, ¼ in. in diameter, the lower end attached to a rod to insure against lateral deflection, inserted over the rim of the tank and operated as a siphon; and for greater depths and particularly for determinations in the lower member of the double-decked tank, through a ¾-in. pipe, equipped with the necessary fittings and connected with a small bicycle pump. In either case flow ceased when a specific gravity of 1.35 was reached.

The slime measured was derived from the crushing of oxidized ore. It contained much iron oxide and was exceptionally slow settling. Water was the suspending liquid, and there had been no lime or other alkali added. Moreover, the work was done during the winter and the temperature of the water was low.

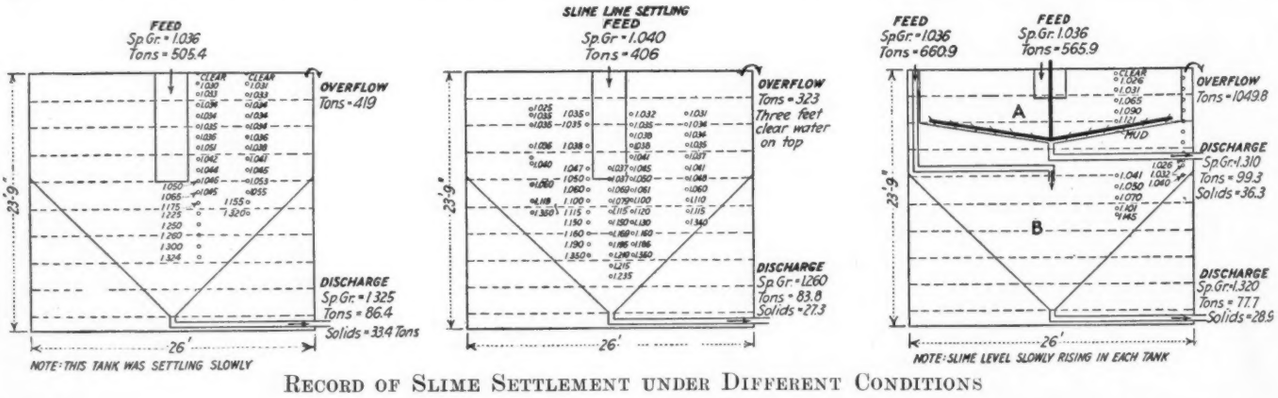
Too much emphasis cannot be given to the fact that conditions of testing were not necessarily parallel. Although Test 3 illustrates practically synchronous conditions in the two compartments, it should be remembered that neither compartment (and more particularly the lower one) is often operated with the upper line of solids in exact equilibrium, but rather, as illustrated in the two series of observations on the single tank, either overloaded (Test 1) or underloaded (Test 2) with the clear-water line either rising or falling in consequence.

*Metallurgist, Homestake Mining Co., Lead, S. D.

Feeding Reverberatory Furnaces Along the Side Walls

The effect of feeding reverberatory furnaces along the side walls is to increase greatly the surface of charge exposed to the flame. David H. Browne in commenting on this fact at the recent A. I. M. E. meeting said that formerly only the bottom, or one side out of four, had charge exposed to the heat of the flame, the other three sides being composed of refractories. The ideal condition would be to have charge exposed on all four sides, approximately as in a cylinder with the flame in the center; this is impossible in the reverberatory but he said we have progressed so that now practically only one side, the roof, has refractories directly exposed to the heat; the surface of the charge has the form of an arc of a circle and covers most of the sides and bottom of the furnace.

When the reverberatory furnaces were built at the Canadian Copper Co.'s plant at Coppercliff, Ont., the furnaces were fed[1] in accordance with the usual Western practice at that time, i.e., introducing most of the charge through hoppers near the firing end of the furnace. In the latter part of 1913 a change was made at Coppercliff and most of the charge has since been introduced along the side walls of the furnace through holes in the roof. There are large charge bins over the side walls at the firing end of the furnace; these discharge into small bottom-dump cars running on 24-in. tracks supported from overhead. Under the tracks a long trough extends down each side of the furnace just above the side walls; these troughs have openings in the bottom 2 ft. apart, communicating by slide gates with 6-in. iron pipes that pass into holes drilled in the roof brick. The furnace charge is introduced through these pipes or openings and slides down on the side walls, over which the charge forms an almost continuous blanket. The feed pipes form a nearly continuous line along each side of the furnace; over the fire wall are six similar openings. On the side opposite the slag door, the charge is fed all the way to the throat; on the skimming side, the charge



Record of Slime Settlement under Different Conditions

[1] "Bull. of A. I. M. E.," January, 1915.

is fed along as far as the slag door and no farther; cold air coming in while skimming cools the wall in that vicinity and obviates the necessity of charging beyond this point to protect the furnace walls.

When the No. 8 reverberatory furnace at Anaconda was changed, in order to try powdered coal as a fuel, no side doors were left in this furnace, as it was thought with the new arrangement for feeding that further fettling or "claying" would not be required. The furnace as remodeled was 124 ft. long by 21 ft. wide, and charging was done from hoppers extending along both sides of the furnace for a distance of 74 ft. from the firing end. The remainder of the furnace, however, required fettling. After operating for three months, Louis V. Bender writes[1] that the bricks were eaten into along each side from the skimming door back to the point where the charge had been dropped. The depth of this cutting was 8 in., close to the skimming end, gradually tapering to zero at a distance of 50 ft. therefrom and was greatest on the side of the furnace having the larger flue connection.

After operating for a while, trouble was encountered in tapping the matte. The taphole was on the east side of the furnace, 83½ ft. from the skimming end. Charging could not be done over the taphole, and for a distance of several feet on either side of it, also owing to the method of charging, matte accumulated at the skimming end of the furnace and could not be completely drained through the side taphole. As a result of the new method of feeding the furnace, the space usually occupied in reverberatory furnaces by the matte was largely taken up by the calcines, forcing the matte to the skimming end of the furnace and preventing its being drawn out of the side taphole. The furnace thus would not hold more than 50 tons of matte, while the other furnaces at Anaconda held 175 tons. It was finally decided to put in a taphole at the side of and below the skimming door, and all matte was thereafter tapped from this opening. The matte tapped amounted to about 35 tons per shift.

The coal ratio for No. 8 furnace in September, 1914 was 7.19 excluding drying coal, and 7.08 when including drying coal. The corresponding coal ratio for a grate-fired furnace using the same coal was 3.88, and the average tonnage 251 as against 476 tons per furnace-day for the coal-dust-fired furnace. The efficiency of the coal-dust firing is increasing with further practice, approaching a fuel ratio of 7.50.

Profiting by the work done by the No. 8 reverberatory at Anaconda, Mr. Bender states that a few changes were made in the construction of the next furnace arranged for coal-dust firing. This furnace is 144 ft. long by 25 ft. wide, inside dimensions; 9 ft. 3½ in. high at the firing end and 6 ft. 6 in. at the "verb." The flue area is 48 sq.ft. The furnace has hoppers for charging calcines and fettling material on both sides for its entire length. In the No. 8 furnace the charge was dropped through 6-in. pipes spaced 19½ in. apart. The new furnace has 8-in. pipes. The tapping of matte is done from the front of the furnace, as in the case of No. 8 furnace. The skimming plate is 12 in. higher than in the old furnaces, thereby giving a larger reservoir for the accumulation of matte; the top of the skimming plate is 24 in. above the taphole. In the discussion of Mr. Bender's paper, E. P. Mathewson said that the new 25x144-ft. furnace had been completed and he had just received a telegram, dated Feb. 15, from the superintendent, who reported on the starting of the furnace as follows: "New No. 5 furnace, Feb. 5, slow wood fire; 10th, up to heat and charged 345 tons; 11th, charged 517 tons, fuel ratio 7.91; 12th, 555 tons, ratio 7.10; 13th, 605 tons, ratio 7.71; 14th, 613 tons, ratio 7.1; everything now O. K. for full tonnage soon." The laconic ending of the telegram caused considerable laughter.

The No. 5 furnace, as also the No. 8 furnace, has been arranged for continuous slag overflow. Mr. Mathewson also announced that the Anaconda company has in contemplation a still longer furnace in which it is proposed to handle converter slag. This slag is now molded in casting machines and resmelted in the blast furnaces. With the prospective discontinuance of blast-furnace smelting, the company has been experimenting and has found that the converter slag can be satisfactorily cleaned in the reverberatory furnace. It now proposes to build a furnace, 175 ft. long and 25 ft. wide, in which the molten converter slag will be poured. On the sides of this furnace will be fed high-silica concentrates that carry sufficient sulphur to help clean the converter slag; part of the charge for this furnace will probably be flotation concentrates carrying 8% copper and about 10% sulphur.

[1]"Bull. of A. I. M. E.," January, 1915.

Leaching Concentrates before Smelting

In the JOURNAL of Jan. 9, 1915, in the article on copper metallurgy by Lawrence Addicks, occurred the following passage:

"At Douglas, Phelps Dodge & Co. has installed a 75-ton test plant after conducting considerable research work, designed primarily to try out leaching on the ores of the Burro Mountain Copper Co. at Tyrone, N. M. The mineral is chiefly a finely disseminated chalcocite in a highly siliceous gangue carrying 10 to 15% alumina. The plan of operation is to give a preliminary concentration, roasting concentrates and tailings separately, leaching both products, sending the leached concentrates calcines with about half the copper extracted to the smeltery at Douglas."

Inquiry was made of Mr. Addicks as to why the concentrates should be leached and then smelted instead of smelting immediately, thereby eliciting the following reply.

"There are two reasons for leaching concentrates calcines in connection with treating the tailings: (1) The high alumina and low copper contents in the tailings give a ratio of extraction embarrassing in both accumulation of alumina in the electrolyte and acid requirements for leaching, while taking some of the copper sulphate in the rich calcines greatly assists in meeting this difficulty; (2) it is necessary to roast the concentrates at the leaching plant to get sulphur dioxide, and there is risk in losing water-soluble copper in shipping these calcines to a more or less distant smeltery by rail.

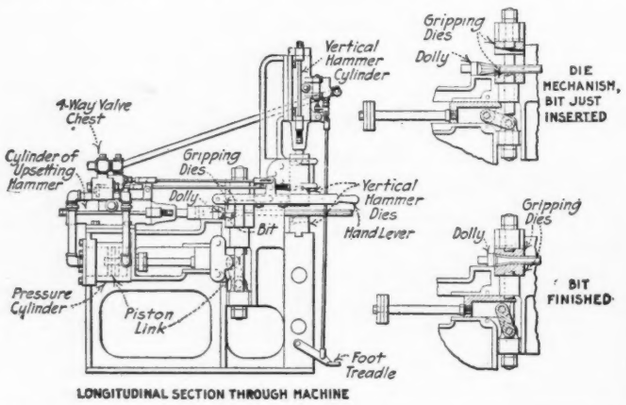
"Commercially, always assuming our large-scale experiments just starting work out as we hope, it seems clear that this copper can be leached as cathode copper directly more cheaply than by smelting. The more I study the general question of handling concentrates the further I am inclined to drive a leaching attack."

Mining & Metallurgical Machinery

Imperial Drill Sharpener

In the Imperial drill-sharpening machine brought out by T. H. Proske, of Denver, the old backing block for holding the steel while the bit is being upset is abandoned for a pair of gripping dies. These do not grip the steel so as to hold it absolutely immovable; they are designed instead to permit the steel as a whole to be moved while the metal of the heated bit is forced into its desired position.

The machine is shown in section in the accompanying illustration. The dull steel is first inserted between the dies of the vertical hammer, and the bit wings are spread out. This hammer is operated by means of the foot treadle shown. The bit is next inserted between the gripping dies, and by means of downward pressure on the



SECTION OF IMPERIAL DRILL SHARPENER WITH DETAILS OF GRIPPING DIE

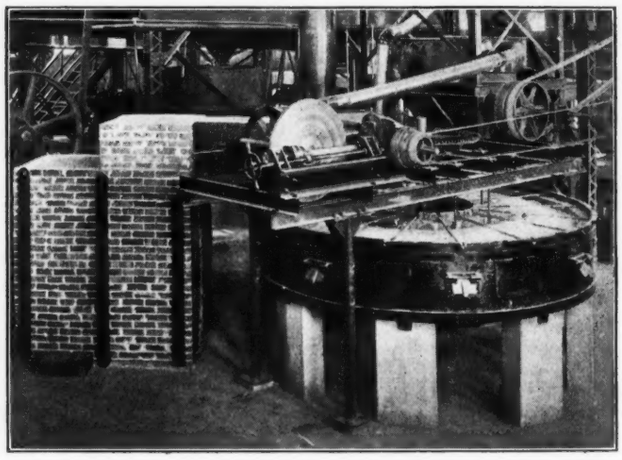
hand lever the four-way valve is open so as to permit the flow of air to the pressure cylinder. This cylinder by means of a link connection brings the dies together on the bit. A further downward motion of the lever opens the throttle of the horizontal upsetting hammer, which then operates striking the shank to which the upsetting dolly is attached and driving the dolly against the base of the bit. The effect of this is to force backward the piece of steel and the center of the bit, while the metal against the dies is held there by friction; the metal is thus drawn into the outer corners of the bit where it is wanted. When the dolly seats against the dies, the bit is finished.

The main frame in this machine is a steel casting, which makes it lighter and more compact; the machine requires a space of 18x48 in. only. A speed of 1015 drills per nine-hour shift is claimed to have been obtained with the machine. It is also pointed out that the vertical hammer does not squeeze or press the heated steel into shape, but beats it out and thus improves its quality. The machine is capable of making any bits up to 3 in. in width. It is also available for upsetting bolt heads, collars on drill steel, etc., while the vertical hammer can be used for general forging.

The Wilfley Rotary-Hearth Roaster

A type of roasting furnace which applies a new principle is the invention of A. R. Wilfley. It is intended primarily to give pyrite ore a magnetic roast, and it will probably find its greatest application in plants making zinc concentrates with magnetic machines.

The Wilfley machine has a circular rotating hearth to and above which heat is supplied from an auxiliary stationary firebox. Rotation of the hearth is effected through a sliding friction-disk set of gears, permitting a close adjustment of the speed of travel over a considerable range. Ground ore is fed to the hearth at that point in its travel where the temperature is the lowest. The new principle mentioned as peculiar to this furnace is in the provision for so adjusting the quantity of feed that it is distributed in a layer or film approximately one grain deep over the surface of the hearth. This affords the hot gases opportunity to give their heat and oxygen rapidly and evenly to every particle of ore, and to bring about the degree of roast that will drive off just enough of the sulphur to render the particles subject to magnetic influence. The



WILFLEY ROASTER AT COLORADO SCHOOL OF MINES

feed, the speed of travel and the intensity of heat may all be independently adjusted. It is found that with average ores the period of roast will not exceed one minute.

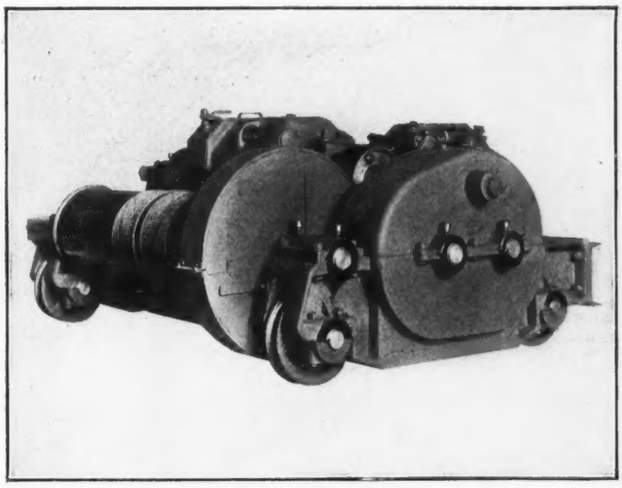
Thus far the manufacturers, the Denver branch of the Mine & Smelter Supply Co., have built this machine only in an 8-ft. diameter size suitable for laboratory purposes. These machines have been placed in the Colorado School of Mines testing plant, Golden, Colo., the Henry E. Wood ore-testing plant, Denver, and the School of Mines, at Ottawa, Can. Experiments with this size of machine have proved that approximately 7½ sq.ft. of hearth area per minute will handle one ton of ore per 24 hr. This is considerably less than the hearth area required in any type of rabbling furnace.

The furnace is maintained at proper temperature through the combustion of coal, wood, oil, gas or any

other fuel. The ore being introduced at the coolest place in the furnace and the travel of the hearth being opposed to that of the gases, the particles of ore are given a rapidly but uniformly increasing temperature until they actually become hotter than the hearth itself when they are directly in front of the firebox. Immediately after passing this point, the roasted ore is withdrawn from the hearth by a suction nozzle (on the principle of the vacuum cleaner) and conveyed by pipe into an air-tight settling chamber through which air is passing to an exhaust fan. This handling of the ore provides also for the removal of its heat. Roasting action is said to terminate instantly as the ore enters the nozzle.

One feature claimed for this new type of furnace is the fact that there is no chance for the agglomeration of the ore grains so that no subsequent rolling or grinding is required before the ore is passed to the magnetic separators. Another point for which strong claim is made is that much less power is needed to drive this machine than is consumed by those machines that carry a heavier charge of ore and depend upon mechanical rabbling. The Mine & Smelter Supply Co. has complete plans prepared for and is ready to supply this type of machine in a 30-ft. diameter size, calculated to roast 30 to 40 tons of ore per 24 hours, as well as in the smaller experimental size spoken of above.

Some Useful Adjuncts to Mining

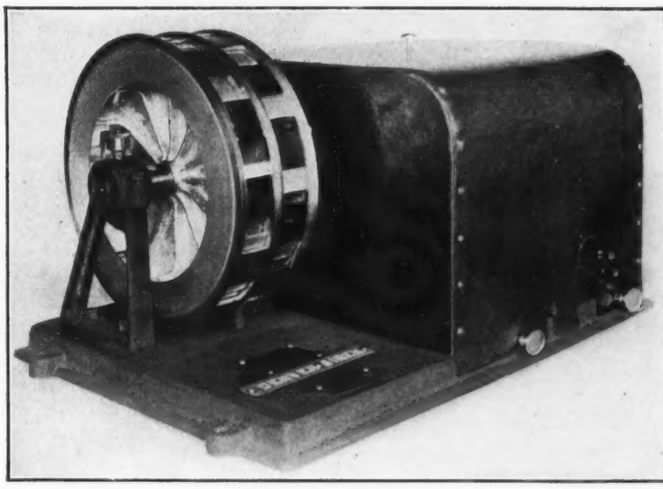


A Safe Crane Trolley

The crane trolley, made in capacities from two to 125 tons, is manufactured by the Northern Engineering Works, of Detroit, Mich., for use in mills. It is completely enclosed, giving safety to the operator and freedom from dust to the motor, but still has its parts easily accessible.

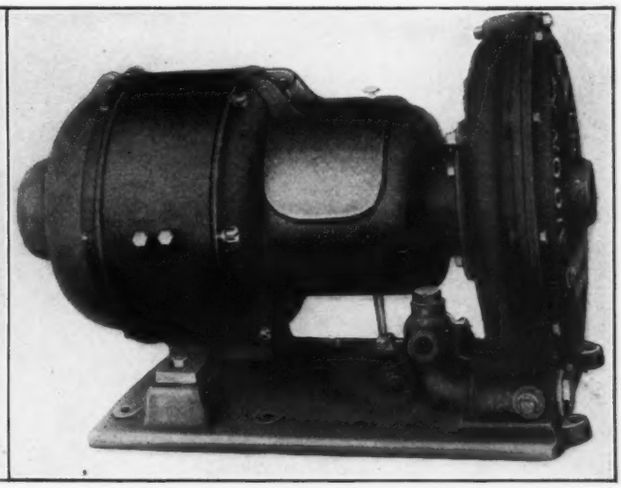
Allis-Chalmers Tractor Truck

This machine, built by the Allis-Chalmers Mfg. Co. for work in rough country, can be used as a truck of five tons capacity, or as a tractor with a drawbar pull of 9000 lb. on the first speed, 2370 on the second. The illustration says all that is necessary as to its cross-country capabilities.



The Denver Siren

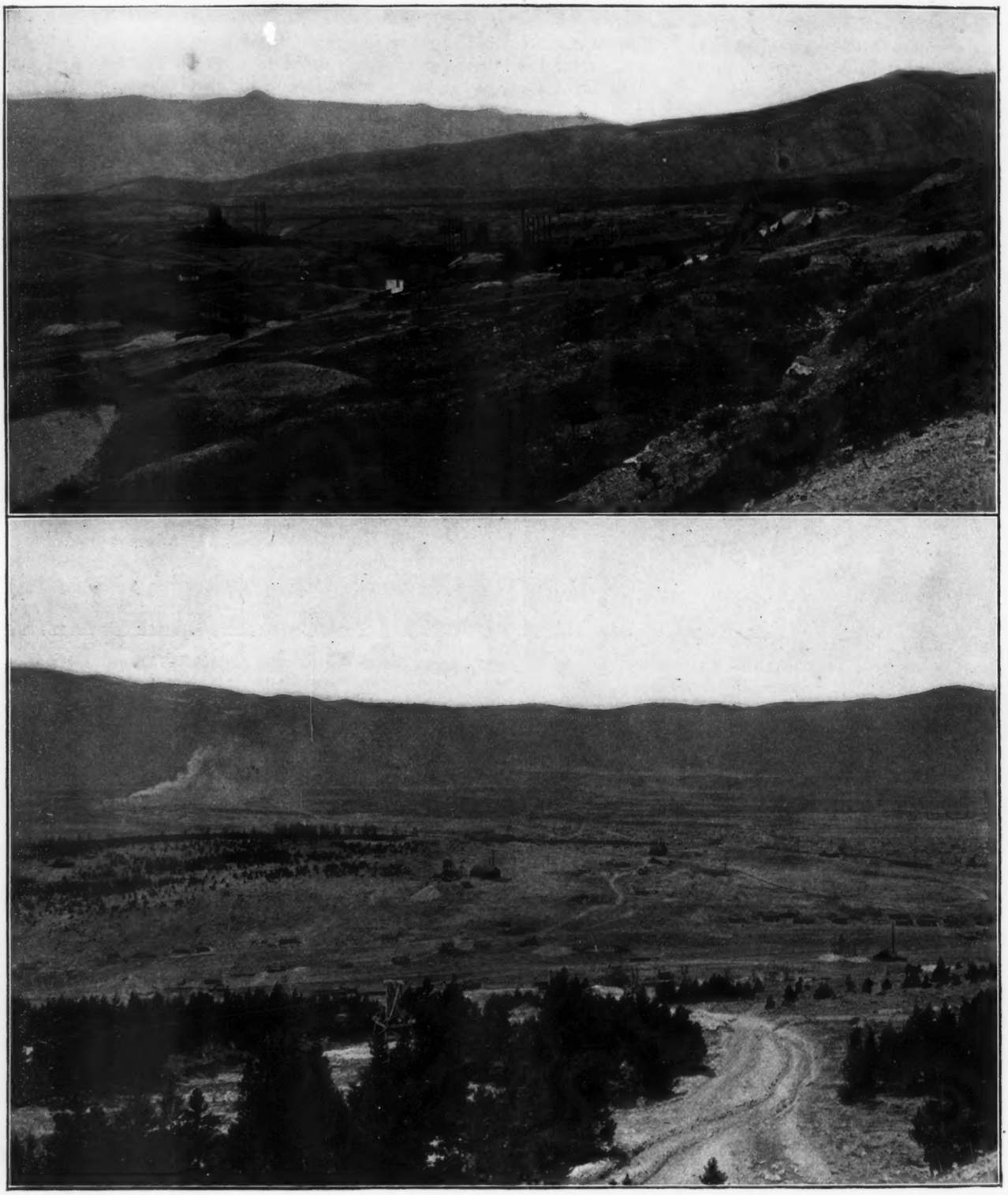
This is a motor-driven siren, designed chiefly as a fire alarm for mills, cities and factories by the Hendrie & Bolthoff Engineering & Supply Co., of Denver, Colo. As the motive power is exclusively electric, the device is handy where no steam is available. It starts by pushing a button. The siren can be heard six miles away.



Compact Electric Lighting Unit

This apparatus consists of an impulse steam turbine direct connected to a small generator. It is designed by the Moon Mfg. Co., 108 N. Jefferson St., Chicago, Ill., especially for use in isolated mines and similar situations, for electric lighting or for driving a few small scattered motors where hydroelectric power is not available.

Photographs from the Field



THE LEADVILLE DISTRICT, COLORADO

The first is a view looking northwest from Iron Hill, showing the Wolftone, Greenback, Pyrenees and R. A. M. mines. The second is a view west from Iron Hill, showing the Sawatch Range, Turquois Lake, Arkansas Valley smelter, part of Leadville, and Carbonate Hill in the middle foreground.

BEATSON COPPER CO.'S PROPERTY ON LATOUCHE ISLAND, ALASKA

The new mill uses gravity and flotation concentration, and began to operate about Feb. 1, 1915. Snowsheds connect the mill with concentrate bins and docks. Other buildings include power house, ore bins, offices, staff houses and boarding house.

TRANSPORTATION OF MINING SUPPLIES IN ALASKA

Pack train crossing the Chena River, on the road from Fairbanks

SURFACE PLANT OF THE FRISCO MINE, IDAHO

At the right is the new mill, now running experimentally, which includes Callow flotation and magnetic separation of lead and zinc

Mines and Metallurgy Exhibit at the Panama-Pacific Exposition

The exhibit of the Steel Corporation is the largest single exhibit in the exposition, several of the subsidiary companies being represented as well. The steel exhibit is installed within a facade of classic lines. In progressive order the visitor will see the iron ore mined in the vast openpit mines of the Vermilion and Mesabi ranges and the Sauntry-Alpena mines of Minnesota, carried to the ore carriers of Lake Superior, then to continue its progress through the great steel plants. The successive stages of the refining of the steel will be shown in Bessemer converters and electric and openhearth furnaces. A blooming mill will exhibit the production of blooms, billets, bars, etc. Special exhibits will show steel alloys, steel mine timbers, wire, cement made from furnace slag, bridges and many forms of steel construction, tin plate, pressed steel and so forth.

A factor in this immense exhibit is the models of mines, factories, ore docks, ore trains, steamer ore carriers. In the model of the ore docks at Duluth, for instance, there are 25,000 separate pieces or parts, each made to an exact scale. This ore dock—the original has a loading capacity of 13,000 tons per hour—will be shown in operation.

The first exhibit to attract the visitor entering the main portal of the Palace of Mines will be the comprehensive display of the U. S. Bureau of Mines. It will be in two sections, one a model mine beneath the floor of the building and the other a large rectangle devoted to metallurgy.

The demonstration mine is beneath the building and it will be a faithful replica with full-size entries, drifts and stopes reproduced from actual mines in the United States. It will be in every respect a model mine operated under modern conditions with complete representation of the most efficient machinery and the methods employed. Ventilating systems and safeguarding of workmen will be impressively demonstrated. Admission to the mine will be free and by means of a regulation mine cage.

In this underground mine the visitor will visit the Goldfield Consolidated properties of Nevada in faithful reproduction. He will see how the pay ore is taken from the Homestead mine; how lead and silver mining is practiced in the Bunker Hill & Sullivan company's plant at Kellogg, Idaho; how copper is mined in the Copper Queen Consolidated mines at Bisbee, Ariz. The bituminous coal mines of the Pocahontas Consolidated Collieries Co. of West Virginia, the Elkhorn mines of Kentucky and the South Wyoming Coal Operators' Association's properties will complete a comprehensive exhibit of coal mining.

Motion pictures are to be provided showing certain operations that it would be impossible to actually reportray. In addition to this exhibition mine there will be a practice drill twice a day, showing the latest and best apparatus for mine lifesaving.

Ray Consolidated Copper Co.

The report of the Ray Consolidated Copper Co. for the last quarter of 1914 shows a production of 9,563,113 lb. of copper: 3,240,118 in October, 3,196,457 lb. in November and 3,126,538 lb. in December. In addition to the copper derived from concentrating ores, 75,473 lb. were from ores shipped directly to smelting plant.

Total ore milled for the quarter was 402,917 dry tons, averaging 1.74% copper. Average mill recovery was 68.2%. Milling cost was 54.56c. per ton, an increase due to the smaller tonnage handled. Average mining and coarse crushing cost of ores milled were 52.388c. per ton, of which 2.666c. was for coarse crushing. Underground development amounted to 3288 ft. during the quarter.

Average cost of net copper produced from milling ores, after allowing for smelter losses and applying the dividends of the Ray & Gila Valley R.R., but no other miscellaneous income, as credit to costs, was 8.748c. Combined cost of copper from all sources was 8.716c. per lb. These costs include all operating and general charges, as well as 12½c. per ton of ore milled which is applied to retirement of mine development costs.

Earnings have been computed on a basis of 10.869c. per lb. for copper.

Improvements at the Reduction Works of the Anaconda Company*

When Mr. Ryan and Mr. Thayer were in Butte last December the important announcement was made that about $6,000,000 would be expended by the company in improvements at the reduction works at Anaconda and Great Falls. These improvements are expected to result in considerable savings in metal values and operation costs and will permit the company to work a lower grade of ore than has hitherto been possible and will thus result in a considerable prolongation of the life of the mines. This action on the part of the company will therefore prove a great benefit to the communities dependent on the company's operations.

At the present time the recovery made on the ore sent to Anaconda and Great Falls is only about 78% of the copper content. It is expected to raise this recovery to about 91% by the use of the flotation process on the concentrator tailings. This will require radical changes in the lower part of the mill. The upper portion will remain much the same as it is now excepting that a Symons disk crusher will be added in each section in order to obtain increased crusher capacity. By so doing the capacity of the concentrator will be increased from about 12,500 to 15,000 tons per day. The jigs on the roll and Huntington mill floors will be replaced by roughing tables of a special design which will make concentrates and coarse tailings. These tailings will be reground in pebble mills so that they will pass a screen with about 60 holes per linear inch. This finely ground sand will then go to the flotation machines which will be situated on the lower table floor and which will make a concentrate containing about 8% of copper and a tailing only about 0.1% copper. The slimes which are now treated on round tables will be further treated in flotation machines, making a tailing which can go to waste and concentrates which will go to the filter plant.

Under the new system there will be no first-class ore and all of the ore from the mines will go to the concen-

*An article by Frederick Laist, metallurgical manager, in "The Anode," February, 1915.

trator instead of being partly sent to the blast furnaces. No coarse concentrates will be produced and the field of the blast furnaces will be greatly restricted, if not entirely eliminated. In order to take care of all of the concentrates which have been going to the blast furnaces, as well as the concentrates which result from the concentration of first-class ore and from the increased recovery on the ore, a new roaster plant will be constructed containing 40 furnaces, 22 ft. 6 in. in diameter. These furnaces will be charged by a conveyor system instead of by cars as are the furnaces in the old roasting plant. The calcines from this plant as well as from the old roasting plant will be hauled by the present tramming system to the present reverberatory plant. The furnaces in this plant are all being enlarged and equipped with pulverized-coal burners. The new furnaces will be 25 ft. wide by almost 150 ft. long and will smelt about 650 tons per day each. The present reverberatory buildings will therefore house furnaces having an aggregate capacity almost 2½ times as great as before, and will smelt all of the concentrates coming from both roasting plants.

The barrel-shaped converters in the converter plant are being replaced by large upright converters of the Great Falls type about 20 ft. in diameter. There will be seven of these converters and they will be able to produce about 22,000,000 lb. of copper per month. The slag from these converters, which is now being solidified and resmelted in the blast furnaces, will be tapped into large ladles and poured from these directly into a huge reverberatory which will be constructed in the relining department of the converter plant. This furnace will be by far the largest reverberatory in the world, and will be 25 ft. wide by 175 ft. long. It will receive about 700 tons of molten converter slag and 350 tons of fine ore per day. The furnace will clean the converter slag to such an extent that it may run to waste.

The new plant will be partially supplied with air from a turbo-blower, having a capacity of about 35,000 cu.ft. of free air per minute. This blower is directly connected to a steam turbine and runs at about 3400 r.p.m. It is now in operation and has proved highly successful. The blast furnace and the briquetting plants will, under the new system, be no longer required, but will be kept intact and in good repair, so that they may be used in emergencies, or at times when the price of copper is high, and it may be advisable to push the copper output beyond the maximum capacity of the other departments.

The improvements at Anaconda will cost about $4,000,000. At Great Falls about $1,750,000 will be spent. A new refinery is being constructed at Great Falls which will have a capacity of 10,000,000 lb. of copper per month. It will replace the old refinery which has been in operation a great many years and which is no longer economical. The new plant will, however, have twice the capacity of the old plant. The refinery will be kept in operation, partly or entirely, on copper shipped from Anaconda; depending on whether or not the Great Falls smeltery is in operation. The new smeltery at Great Falls will be completed and the pulverized coal system, which has proved so successful in Anaconda, will be applied to the Great Falls furnaces. Coal from the Lochray coal fields is to be burned. The ash content of this coal is high, but this has not proved detrimental. Both the output per furnace and the tonnage smelted per ton of coal will be greatly increased over the old system of gas firing. No concentration of ore will be done at Great Falls. All of the ore will come to Anaconda and concentrates only will be shipped from there. The blast-furnace department at Great Falls will also be closed down and all smelting will be done in reverberatories, as in Anaconda.

The new leaching plant at Anaconda, which will be operated on tailings which have accumulated during the past years to such an extent that about 15,000,000 tons are available for retreatment, is nearing completion, and will probably be started early in April. It will treat from 2000 to 2500 tons per day of tailings containing from 13 to 14 lb. of copper per ton, and will make from six to seven hundred thousand pounds of copper per month at low cost. The supply of tailings for this plant is sufficient to keep it in operation for a period of about 20 years.

The new acid plant is also nearing completion and will be able to make somewhat over 100 tons of acid per day. This acid will be used in the leaching plant and in the new flotation plants.

The company has much experimental work under way along various lines, which may in the course of a few years lead to the establishment of other important lines of industry at Anaconda and other points.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

DRILLING—Dust Collector for Rock Drills. Emmet F. Galligan, Idaho Springs, Colo., assignor of one-half to Henry E. Woodward, Denver, Colo., and one-fourth to William H. Galligan, Idaho Springs, Colo. (U. S. No. 1,127,225; Feb. 2, 1915.)

DRILLS—Front-Head Construction for Self-Rotating Hammer Drills. Lewis C. Bayles, Easton, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. Nos. 1,126,941 and 1,126,942; Feb. 2, 1915.)

HOISTING—Automatic Brake-Setting Device for Mine Hoisting Engines. Alfred William Charles and Charles Edward McDonald, Butte, Mont.; said Charles assignor to said McDonald. (U. S. No. 1,127,183; Feb. 2, 1915.)

HOISTING—Safety Device or Arrestor for Colliery Winding Cages, Hoists, and the Like. Jack Yates and Charles Heyes, St. Helens, England. (U. S. No. 1,127,713; Feb. 9, 1915.)

LADLE FASTENING, Frederick H. Beebe, Elyria, Ohio. (U. S. No. 1,126,687; Feb. 2, 1915.)

METAL-MELTING FURNACE or Retort. Maurice Goldberger, Fort Wayne, Ind. (U. S. No. 1,125,090; Jan. 19, 1915.)

METALLIC COATING and Process of Making Same. Max Ulrich Schoop, Höngg, near Zurich, Switzerland, assignor, by mesne assignments, to Metals Coating Co. of America, Boston, Mass. (U. S. No. 1,128,058; Feb. 9, 1915.)

MINE-CAR STOP. John T. Pero, Parsons, Penn., assignor of one-fourth to James R. Fleming and one-fourth to Gary N. Gray, Scranton, Penn., and one-fourth to William Harris, Parsons, Penn. (U. S. No. 1,126,562; Jan. 26, 1915.)

PULVERIZER. William K. Liggett, Columbus, Ohio, assignor, by mesne assignments, to The Jeffrey Manufacturing Co. (U. S. No. 1,125,137; Jan. 19, 1915.)

SEPARATOR—Planetary Centrifugal Separator. Wilhelm Mauss, Johannesburg, Transvaal, South Africa. (U. S. No. 1,126,547; Jan. 26, 1915.)

SINTERING PROCESS for the Recovery of Metallic Oxides from Flue Dust. George F. Downs, Buffalo, N. Y. (U. S. No. 1,127,209; Feb. 2, 1915.)

SIZING—Apparatus for Sizing or Volumetric Grading Materials. Charles L. McKesson, Colorado Springs, and Benjamin F. Rice, Denver, Colo. (U. S. No. 1,127,469; Feb. 9, 1915.)

SLAG STEAM GENERATOR. Charles H. Smoot, New York, N. Y., assignor to Slag Steam Generator Co., New York, N. Y. (U. S. No. 1,127,690; Feb. 9, 1915.)

SMELTING FURNACE. Edwin Vincent Lanyon and Francis Albert Curnow, Pittsburg, Kan. (U. S. No. 1,127,264; Feb. 2, 1915.)

STEEL—Improvements in and Apparatus for Carrying the Steel from the Steel Furnace to the Roller Mills and for Casting the Ingots en route. A. H. Cooper, Irlam, nr. Manchester, Eng. (Brit. No. 21,066 of 1913.)

TUNGSTEN—Method of Treating Mill-Scale. Frederick M. Becket, Niagara Falls, N. Y., assignor to Electro Metallurgical Co., Niagara Falls, N. Y. (U. S. Nos. 1,127,162 and 1,127,163; Feb. 2, 1915.)

Editorials

Zinc Smelters' Roasting Furnaces

The accompanying table, exhibiting the kind and number of the roasting furnaces in the zinc-smelting works of the United States and their aggregate daily capacity, is of interest. Save in the few cases noted as estimated, the data were officially communicated by the several companies, and stand as of Dec. 15, 1914.

The capacity is given in terms of tons of 2000 lb. of raw ore. The total is 2753 tons per day, or about 1,001,000 tons per annum, reckoning 360 days. However, about 201,000 tons of this was in works that did not produce spelter in 1914, leaving 800,000 for the works that were active. Of the works that did not produce spelter in 1914, two of them (Langeloth and Granby, East St. Louis) were new plants coming into operation in 1915, and their roasting capacity was 57,600 tons. The main part of the remainder of the ore-roasting capacity in 1914 was in moribund plants, the further operation of which is doubtful. An allowance must be made for the time when furnaces must be cold for repairs. Let us assume 750,000 tons as the total roasting capacity among the smelters who were active in 1914. The total amount of ore treated by those smelters was probably about 925,00 tons.

The figures for roasting capacity are not to be taken as anything but approximations, the capacity of the same furnace being variable according to the ore roasted. Thus a furnace roasts fewer pounds of flotation concentrate per square foot of hearth area than it does of Joplin blende. However, we get an idea of how things stand in the American zinc industry taken as a whole. The works operating in 1914 were about 175,000 tons short in roasting capacity. This corresponds approximately with the supply of calamine, whereof about 150,000 tons per annum is obtained from Leadville, about 16,000 tons from the Joplin district, a few thousand tons from Nevada and southeastern Missouri, besides which there is the noncompetitive output of the Franklin mine, which goes to the New Jersey Zinc Co. We may see that the smelting capacity is limited rather by the roasting capacity than by the distillation capacity (of which there is a great surplus) and why when the supply of Mexican calamine became largely cut off there arose so eager a demand for Leadville calamine that smelters were willing to take a very low grade of it and guarantee a high price for spelter as the basis of settlement.

This is a condition that is likely to change. The natural-gas smelters were eager to obtain calamine in order to keep their works going at as nearly 100% capacity as possible. They were not disposed to put any more money for additional roasting furnaces into plants that were soon to be discarded anyway. And, moreover, the consumption of gas, already scarce and costly, was reduced by smelting an ore that did not require roasting. The plants that are being built in the Eastern coal fields are, without exception, equipped for the manufacture of sulphuric acid, which implies roasting facilities. The sulphuric-acid makers at the end of 1914 had about 455,000 tons of roasting capacity, besides which there was about 40,000 tons at the Langeloth plant, just going into operation and something additional at East St. Louis. The movement of the zinc-smelting industry toward the East foreshadows a disappearance of the premium on calamine. Will the concentration of large productions of sulphuric acid between St. Louis and Chicago and between Pittsburgh and Wheeling reduce the price of that commodity and consequently the terms for blende ore?

It is interesting to examine the types of roasting furnaces in use by American zinc smelters. These are mechanical with but few and insignificant exceptions. The old hand-rabbled shelf-burners continue in use at Iola (two works) and Pittsburg, Kan.; also at the Carondelet plant of the Edgar Zinc Co., while at Peru there remain two muffled shelf-burners. With respect to the mechanical furnaces generally in use there are scarcely any novelties. The sulphuric-acid makers use the Hegeler furnace without exception. This was first introduced about 1882 and during 34 years has undergone surprisingly little change. Structurally it has been improved, but in principle and to the most extent in mechanism it is the same as in 1882. The United States Zinc Co. abandoned the Rhenania hand-raked furnaces that it had originally and uses the Hegeler for simple roasting without sulphuric-acid manufacture.

Among the furnaces used for roasting alone, the Brown (both circular and straightway) is in use at two active works and survives at another works temporarily idle. The Ropp furnace, as modified by Cappeau, is in use at three works. and the Zellweger furnace at seven works.

BLENDE ROASTING FURNACES

Company	Place	No.	Kind	Daily Capacity
Altoona	Altoona	3	Zellweger	90
Amer. Z. & C. Co.	Langeloth	2	Hegeler	110
Amer. Z., L. & Sm. Co.	Caney	4	Zellweger	120
Amer. Z., L. & Sm. Co.	Dearing	3	Zellweger	90
Amer. Z., L. & Sm. Co.	Hillsboro	2	Hegeler	80
Bartlesville	Bartlesville	5	Zellweger	150
Bartlesville	Collinsville	6	Ropp-Cappeau	150
Chanute	Chanute, Kan.	3	Machine	30
Collinsville	Collinsville, Ill.	4	Brown	50
Edgar	Cherryvale	9	Brown	130
Edgar	St. Louis	5	1 Brown 4 Hand	20
Granby	E. St. Louis	1	Hegeler	50
Granby	Neodesha	2	Zellweger	60
Grasselli	Clarksburg[1]	3	Hegeler	120
Grasselli	Meadowbrook[1]	4	Hegeler	160
Hegeler	Danville	2	Hegeler	*e* 80
Illinois	Peru	3	Hegeler	*e* 120
		2	Hand	*e* 20
Laharpe	Laharpe	2	Hand	*e* 20
Robt. Lanyon	Hillsboro	1	Hegeler	44
Lanyon-Starr	Bartlesville	2	Zellweger	60
M. & H.	Lasalle	4	Hegeler	155
Mineral Point	Depue	7	Hegeler	294
National	Argentine[2]	2	Hegeler	100
National	Bartlesville	4	Zellweger Rissmann & Ruebel	130
Prime Western	Gas	6	Hand	30
Prime Western	Tiltonville, O.[3]	2	Hegeler	90
Tulsa F. & M. Co.	Collinsville	2	Ropp-Cappeau	50
Tulsa Spelter Co.	Sand Springs	2	Ropp-Cappeau	70
U. S. Zinc Co.	Pueblo	2	Hegeler	*e* 80
			Total	2753

[1] There are no roasting furnaces at these works. The numbers entered are the furnaces at other points which supply them. [2] The roasting furnaces at Argentine supply the smeltery at Springfield. [3] This roasting plant supplies other smelteries.

e Estimated.

All of these furnaces date back at least 15 years. At Bartlesville, Mr. Rissmann has a new furnace, which is about the only new thing in blende roasting in this country.

Fireproofing Mine Shafts

The matter of fireproofing mine shafts is important. In the case of new shafts, the problem is frequently met by all-steel, or steel and concrete, or concrete construction. This does not, however, meet the case of an old timber-lined shaft. To tear out the whole system of shaft timbering and replace it with a fireproof lining would, in many cases, entail too much time and money. Even acknowledging the advantages of concrete, or steel and concrete lining, the cost is often prohibitive and the timber-lined shaft is therefore still the rule. And a timber lining offers many advantages in itself. The lining operations can follow the sinking easily and closely, the units are handled economically and can be quickly adjusted to suit local shaft conditions. If the timber could be made fireproof, therefore, it would be an excellent lining material. A system of fireproofing, permanent, safe and within the cost limit, especially one applicable at any time after sinking is completed, ought to find a large field in the mining industry.

There appears in this issue of the JOURNAL a description of a job in which a cement-gun was used to sheath the wood and steel framing of a steeply inclined shaft in the iron country. The cement-gun has been used for this purpose in other instances also and offers interesting possibilities for underground work. The machine, as is known, is one which deposits cement mortar by an air blast and is peculiar in that the material is mixed dry and no water is added until the material reaches the discharge nozzle. It is claimed that the hydration of the material really takes place in the air between the nozzle and the place of deposit, the initial set of the cement taking place on the structure and not in the mortar box. The nozzle is directed against the work as an ordinary garden hose is used. The layer of cement mortar so deposited has been given the trade name "Gunite." No forms are required for the work. In shaft jobs where timber is to be coated, the wood is first thoroughly cleaned and washed, this work being done with the machine, and then a layer of wire mesh is stretched evenly over the surface and fastened in place at the proper distance therefrom. This reinforcement is provided to take care of the temperature stresses, to give the lining homogeneity and elasticity and to increase the adhesion of the coating to the timber.

It is maintained that this coating is not only fireproof, but also dense and waterproof, thereby preventing the decay of the timber work, since the timbers become waterlogged and much less subject to decay.

This method of fireproofing was not considered for the job described until the shaft lining itself was completed. If the coating had gone hand-in-hand with the regular lining work, it is claimed by the advocates of the method that the use of the 3-in. lagging between the steel sets could have been obviated by increasing the thickness of the Gunite and placing it in the form of flat arches between the set members. Only a light lagging strong enough to afford protection during sinking, would have been necessary and this could have been placed outside the steel.

Another shaft which has been fireproofed with Gunite is the new shaft of the Old Ben Mining Co.'s No. 9 mine near West Frankfort, Ill. This is a vertical coal shaft about 600 ft. deep. It is protected by a 2-in. lining, reinforced as described above.

In considering the use of the process, the item of cost is usually the controlling factor. From the very nature of the work, however, it is obviously impossible to name any hard and fast figure which could govern all cases. The Cement Gun Construction Co. states that the price depends so much upon local conditions, material and labor cost, and other details, that it is necessary to make a special estimate for every job. Where compressed air can be furnished by the mine, and under normal conditions, the cost of the Gunite coating per square foot, it is stated, should be about 20 to 22c. for a 2-in. application and from 15 to 18c. for a 1½-in. thickness. This will include all material, labor, transportation and superintendence, except cage service, which is always furnished by the mine. Under favorable conditions this can be reduced, while in cases where large amounts of water are encountered or where material or labor is high, an increase may be necessary.

Gold Stealing in Siberia

In reporting to the stockholders of the Lena Goldfields, Ltd., the English company which controls the Lenskoi Gold Mining Co. and through it operates rich placer ground in Siberia, the consulting engineer refers to the thefts of gold from the company's works as one of the chief sources of high cost of operation. C. W. Purington, the consulting engineer, has had much experience in the class of mining carried on at the Lenskoi, both in Russia and in other countries, and he puts the company's actual loss by theft at $500,000 yearly. This seems a large sum, but the evidence of other foreign engineers who have operated Siberian mines makes it quite probable; especially as the gold at the Lenskoi is generally free, and much of the work is done by hand. Mr. Purington philosophically accepts the fact that wherever gold or precious stones are produced there is risk of theft, but he proposes to reduce the loss by substituting machinery for hand labor wherever possible and by building change houses and requiring miners to change clothes upon leaving work.

These measures might lessen the amount of theft, but could hardly do away with it altogether. The *starateli* of Siberia are rather an independent class and much given to roving. They have been brought up generally in the old lines, are expert in concealing gold and do not seem to regard it as a crime, doubtless looking upon it as a sort of commission to which they are entitled. It can be readily disposed of, for wherever there is stolen gold, illicit buyers are ready. Foreign engineers who have been in Siberia have all commented on the thefts and some have even sought to estimate some definite percentage of the total output.

The Siberian miners are not the only gold thieves in the world; we have even heard of "high-graders" in Colorado and elsewhere in our own enlightened country, to say nothing of Australia.

Outside of the stolen gold, however, there is "free gold" in Siberia, which is not stolen from the point of

view of the operators, but is contraband by the government standard. Under Russian law all gold won is to be turned over to the government collectors, who pay for it by drafts on the various mining centers, after deducting the government tax or royalty. But many, especially the smaller operators, find it convenient to have a reserve which is not returned to the officials, but is carried or disposed of in various ways. This is a custom which is of old standing. Some engineers of long experience claim that the stolen gold and the free gold amount to at least 15% of the total, and it is always entirely safe to add 10% to the official returns to get at the Siberian production. The majority think 10% is too low; in some remote districts and near the Mongolian border 20% might be nearer the mark. We can only say that a gold-mining company which—like the Lena Goldfields—can lose $500,000 a year by theft and still pay dividends, is a very fortunate one.

BY THE WAY

An interesting view of the Mexican situation was that given in the speech of Chairman R. T. Bayliss of the Exploration Co., Ltd., at the ordinary annual general meeting of the company in London, Feb. 3, 1915.

You will expect some remarks from me with regard to the Mexican situation. I approach this subject with some hesitation, for it is one on which those most competent to form and express an opinion are very reluctant to make any prediction regarding the future. The capable correspondent of "The Times," writing under date of Dec. 11, sums up the conditions prevailing last year as follows: "The conditions of the past year in Mexico have been unprecedented. The whole country has been in arms. Revolution has succeeded revolution. Various factions contending for supremacy are still at war, and the outlook, from a political, financial and economic standpoint, is clouded by many uncertainties." That statement expresses very succinctly and very accurately the conditions as I understand them today. Of the mistakes that have been made in the administration and in the interference with the administration of Mexico during the past two years one could talk by the hour; but it would not serve any good purpose. Grave mistakes have undoubtedly been made, but those who have interests in Mexico and the welfare of the country at heart can employ themselves more profitably in lending the weight of their counsel and influence toward a restoration of more settled conditions than in criticizing the errors of the past. In my opinion the great mass of the population of Mexico is neither fitted for, nor do these people want, nor are they competent to conduct, the affairs of the country under a so called constitutional government. On the other hand, they are not willing, as I understand them, to submit again to the rule of a dictator, even if another should arise so familiar with the needs of the country and so competent as the late President Diaz. Politically the country is, I believe, passing through a period of transition and cries aloud for the help and guidance of some constitutional power or powers to tide it over this period, and to do for Mexico, with the aid of some equally capable adviser, what Lord Cromer and his successors have done for Egypt. Under such guidance peace would be restored, the excuse for factional differences would be removed and Mexico would soon take a prominent place in the economic progress of the world.

Chronology of Mining for January, 1915

Jan. 4—London Stock Exchange reopened.

Jan. 7—Federal district court at San Francisco declares Arizona's alien law to be unconstitutional.

Jan. 11—Strike started in Miami and Globe.

Jan. 12—Annual meeting of Mining and Metallurgical Society of America.

Jan. 13—Copper Producers' Association dissolved.

Jan. 24—Strike in Globe-Miami district settled; work resumed at increase in wages.

Jan. 25—Spelter price, East St. Louis, passed 7c.

Jan. 26—U. S. Steel Corporation common dividend passed.

Jan. 27—Announcement of raise in wage scale at Bisbee following higher price of copper.

St. Joseph Lead Co.

The fiscal year of the St. Joseph Lead Co. has been changed to conform to the calendar year and its report, just issued, gives the results from its Missouri properties from Apr. 30 to Dec. 31, 1914, as well as for the calendar year. The combined net income of the St. Joseph Lead and affiliated companies for the eight months was $966,-317; for the calendar year, $1,547,275. Dividends to the amount of $258,390 were paid from the income of the calendar year. The profit and loss surplus for 1914, after deducting dividends, was $1,273,580 and the total profit and loss surplus at the end of 1914 was $9,416,628. The average price received for lead at East St. Louis, Ill., in 1914 was $74 per ton, the lowest in 16 years; during the previous fiscal year the price averaged $81 per ton.

Owing to the decreased demand for lead, the company's properties were operated only at 75% capacity after October. The output for the calendar year was 77,404 tons as against 65,615 tons during the previous fiscal year. The mines of the Bonne Terre division in 1914 produced 508,649 tons of ore; there were milled 505,123 tons, of which 418,739 tons were treated in the Bonne Terre mill, 68,757 at Rivermines and 17,627 at Leadwood. Milling operations were discontinued at the Bonne Terre mill about the middle of October when mining operations were curtailed 25%. The cost of mining was $0.6337 per ton or 16c. less than last year. In the Leadwood division, there was a production of 516,878 tons from the mines at a cost of 75c. per ton. Development in the Bonne Terre division cost $8.57 per ft.; in the Leadwood division $5.12; diamond drilling cost 43c. and 61c., respectively. The milling costs in the two divisions were: In the Bonne Terre division, 34.07c. per ton of ore treated; in the Leadwood division, 28.94c. per ton.

Doe Run mined 966,273 tons and treated 967,976 tons. Diamond drilling cost 55.9c. per ft.; development, $10.53 per ft.; mining, 65.6c. per ton; milling, 27c. per ton. The mining costs were 5c. lower than in the previous year, due mainly to the introduction of automatically rotated sinkers, and an increased tonnage of about three-quarters of a ton per man-shift.

About $136,000 were spent in 1914 in completing the improvements outlined for the smelting plant at Herculaneum, Mo., and the recovery now shows a gain of 5% over what it was four years ago, while the cost of producing a ton of pig lead is now about $2.25 lower, though part of this improvement is due to higher-grade concentrates being produced in the mills.

No further new construction of an important nature is now contemplated. The grade of the ore was maintained by the mines in 1914 and costs were reduced in most departments. Labor conditions were satisfactory and wages were not reduced, despite the low price for lead. The contract with the State Board of Mediation expired on Aug. 26 and was not renewed. A system of old-age pensions was established last year.

PERSONALS

J. R. Finlay has returned to New York.

N. V. Hansell, of Hamilton & Hansell, is on his way to Russia.

Morton Webber is now in London, having sailed from New York Jan. 27 on the steamship "Baltic."

W. P. Snyder, president of the Shenango Furnace Co., Pittsburgh, has gone to Palm Beach, Fla., to remain until April.

H. C. Enos was married in Salt Lake City, Feb. 16, to Miss Caroline Nolan. Mr. Enos' present address is Hotel Paso del Norte, El Paso, Texas.

C. W. Purington, with Mrs. Purington and young child, are passengers on the "Tuscania" of the Cunard line, which sailed Feb. 20 from New York for Liverpool.

J. M. Hill is to conduct an examination of the placer deposits of the United States for the U. S. Geological Survey. The work will occupy over a year, it is expected.

Thomas T. Gray, for many years chief chemist of the Tidewater Oil Co. at Bayonne, N. J., has opened a research and consulting laboratory at 1343 North Ave., Elizabeth, N. J.

W. G. Trethewey, formerly of Toronto and largely interested in Cobalt mines, now residing in Sussex, England, has recently undergone a successful operation for appendicitis.

S. W. Cohen, general manager of the Crown Reserve Mining Co., Cobalt, Ont., will shortly leave for Nicaragua accompanied by a staff of engineers to investigate a gold property on behalf of the company.

Henry Jaxtheimer has been elected safety engineer at the plant of the Sharon Steel Hoop Co., Sharon, Penn. This is a new position the company has created as the result of recent compensation and accident legislation.

R. M. Hosea has resigned as chief engineer of the Colorado Fuel & Iron Co., the Colorado & Wyoming Refining Co., and the Crystal River R.R., effective Feb. 15. He will retain a consulting engineer engagement with the above companies and is open to any outside engagement.

Charles Janin, of San Francisco, is to conduct an investigation into gold dredging in the United States for the Bureau of Mines. The work will occupy some time and will be more or less related to the placer examination which J. M. Hill is conducting into placers for the Geological Survey.

A memorial to the late Thomas J. Grier at Lead, S. D., is proposed by the employees of the Homestake Mining Co. They have appealed to his old friends and business acquaintances to aid them by subscriptions to their fund. Richard Blackstone, Lead, S. D., is chairman of the committee.

Dr. James Douglas was made an honorary member of the American Mining Congress at a recent meeting of its Board of Directors. The presentation of the diploma to him occurred at a luncheon party at the Engineers' Club, New York, Feb. 17, at which Carl Scholz, President of the Congress, presided. About 20 prominent mining engineers were present.

Kurt Orbanowski, formerly in charge of the Putiloff shipyards in Russia, and Jacob Eton Conner, for a number of years American consul at Petrograd, Russia, are in this country looking into the purchase of tin, lead, spelter and other metals and materials for export to Russia. They are making their headquarters at the office of the Ingersoll-Rand Co., 11 Broadway, New York.

OBITUARY

William Dick, a wealthy merchant and large mine operator in southern Colorado, was killed Feb. 13, as he was driving in his automobile from Walsenburg to La Veta, Colo. It is believed that the murderers were not robbers, but that the shooting was the result of enmities arising from the mine troubles last spring. No attempt was made at robbery, though Mr. Dick had a large sum of money with him. According to local accounts his property had been threatened with destruction. He had refused to sign any agreements for working scales at his mines, running his property on an independent basis. William Dick was a stockholder in the Turner, the Solar and the Nigger Head mining companies and part owner in the Gordon Mining Co., all located near Walsenburg, besides being interested heavily in the Rugby company near Aguilar. He was president of the Pinon Supply Co. and of the Walsenburg Wholesale Mercantile Co. He leaves a widow and eight children, all living in Walsenburg. He was 50 years old.

Arthur Keen, one of the best known men in the British iron industry, died Feb. 15, aged 80 years. As a young man he was first employed as a railroad clerk, but 60 years ago he entered the firm of Watkins & Keen, which began in a small way the manufacture of bolts and nuts by newly devised machinery. By years of expansion and consolidation this small firm gradually developed into the important corporation of Guest, Keen & Nettlefolds, Ltd., owning mines, blast furnaces, steel works and rolling mills. Mr. Keen was for a number of years managing director and later chairman of the company. He was also a large stockholder and director in the great steel making house of Bolckow, Vaughan & Co. Mr. Keen was quite prominent in politics and was a close friend of Joseph Chamberlain. In 1904 he was a member of Mr. Chamberlain's tariff commission. On several occasions he acted as an arbitrator in labor disputes. Mr. Keen was a vice-president of the Iron & Steel Institute, and of the Institute of Mechanical Engineers. He leaves three sons, of whom two are directors of Guest, Keen & Nettlefolds.

SOCIETIES

Iron & Steel Institute—The secretary gives notice that the annual meeting will be held at the Institution of Civil Engineers, Great George St., London, S. W., on May 13 and 14. May 13 has been provisionally fixed for the annual dinner, and a further announcement will be made if it is found possible for the dinner to take place.

Northwest Mining Convention—At this meeting, held in Spokane, Wash., Feb. 22-27, the special mining features were in charge of the Columbia Section of the American Institute of Mining Engineers. On Feb. 24 there was an address by F. A. Ross, chairman of the section, reviewing mining in the Northwest. Papers presented were "Mine Models," by F. W. Callaway; "Economic Geology of Northeastern Washington," by F. M. Handy. Discussions followed. On Feb. 26, miners' and prospectors' day was occupied by short addresses and discussions.

International Engineering Congress, 1915—Notwithstanding the difficulties arising as a result of the present European war, the Committee on Papers is able to count on from 200 to 250 papers and reports covering all phases of engineering work and contributed by authors representing some 18 different countries. The Congress will therefore be truly international in scope and character, although the representation from the countries involved in the European war will naturally be less than originally planned. The papers are now rapidly coming in and their character gives the fullest assurance that the proceedings will form a most important collection of engineering data and a broad and detailed review of the progress of engineering art during the past decade. The Committee of Management is now issuing to all important engineering societies, in this country and abroad, invitations to appoint official delegates to attend the sessions of the Congress, and the presence of a considerable body of such delegates is well assured. Membership in the Congress with the privilege of purchasing any or all of the volumes of the proceedings is open to all interested in engineering work.

INDUSTRIAL NEWS

The Calumet & Hecla Mining Co. has just completed the installation of 12 large Hardinge mills in its new White Pine concentrator.

The Keasbey & Mattison Co. has recently appointed Howe Brothers, 1198 San Pedro St., Los Angeles, Calif., as its agents for covering and textile goods for California south of Fresno, and also for Arizona, New Mexico and Utah.

The Hardinge Conical Mill Co. has recently entered into a contract with the Anaconda Copper Co. covering sixty 10-ft. diameter Hardinge mills, 20 of which are to be installed immediately, the others following throughout the year.

Edward M. Hagar has resigned as president of the Universal Portland Cement Co. He intends to organize a combination of portland cement producers. His successor is Benjamin F. Affleck, who has been with the company since it was organized.

Editorial Correspondence

SAN FRANCISCO—Feb. 17

Thirty-Five Suits have been filed in the United States District Court at San Francisco against the Penn Mining Co. operating a copper mine and smeltery at Campo Seco in Calaveras County. These suits are brought by farmers in Amador and Calaveras Counties for alleged damage to crops and soil by fumes from the smeltery. Two of these suits were filed on Dec. 31, another followed shortly after, and 32 more were filed in the first part of February. The largest amount of damage claimed by a single farmer is $27,769 and the smallest amount $2262. The whole of the 35 suits amounts to $334,314. They followed the report of the state commission appointed by Governor Johnson for the investigation of waste and damage from the smelteries of the state. This commission examined conditions about Campo Seco and also in the region affected by the Mammoth smeltery in Shasta County. The report was unfavorable to the Mammoth, but it was not vitally unfavorable to the Penn Mining Co. The absurdity of these actions is quite apparent not only on the basis of the report of the state commission, but from the fact that the farmers did not themselves initiate the suits. A San Francisco firm of attorneys went among the farmers in the Campo Seco region and made contracts for the bringing of such actions against the Penn Mining Co., providing for a division of the money damages that may be secured through the court. And besides that, the supervisors in Amador, Calaveras and also San Joaquin Counties declined to bring such actions upon showing that had previously been made by some of the farmers. Another evidence of the absurdity of the suits is that in some cases, if not practically all, the value of the land forming the basis of demand for damages has been placed greatly in excess of actual value. For instance, in one case of former suit brought, the entire acreage of the farm was counted for the valuation placed at $125 per acre. The larger proportion of this land had absolutely no agricultural value, and the remainder had an actual value of about $40 per acre. The farmers in the Campo Seco region some time ago gave up all hope of making a damage suit lie against the Penn Mining Co. The smeltery has at times without doubt discharged some small quantities of SO_2 and a slight amount of damage has in the past been done. Recently and for the past two years every effort has been made by the company to prevent the discharge of such damaging fumes and within the past half year a comparatively small amount of smelting has been done while the main efforts of the company have been directed to the development of new orebodies. A fault was disclosed in the vein formation, and after a large amount of exploration and development the vein was again picked up. The labor devoted to the development of new orebodies has necessitated the curtailment of smelting operations, and beside that, the effect of the European war upon the copper industry further necessitated curtailment of smelting. There has been practically no damage done to any of the crops or the soil in this region. Some of the farmers who are included in these suits, in fact most of them, express no particular interest in them, having merely given the attorneys such facts as they required and signed the contract for division of the spoils, if there should be any spoils. The attorneys assume the expense of bringing the suits and it is quite likely that the chief purpose in the commencement of the actions was to impress the Penn Mining Co. with the idea of entering into a compromise and giving all the farmers a pro rata of such aggregate amount as might be agreed upon. The Penn Mining Co. of course is prepared to meet the actual trial of any or all of these suits, but it is not at all probable either one or any number of them in combination will be tried when the suits are brought fairly before the court. In the first place, there has not been sufficient expert examination to provide evidence upon which to base judicial action and it is quite certain that the report of the state commission respecting the Penn Mining Co. can not be construed as a basis of action for money damages. An interesting feature of the situation in the Campo Seco region is that no complaint has ever been made by the owner of the largest and most prosperous farm in the region, which is situated in about the center of the so called "smoke belt." This farm has an area of approximately 400 acres, and despite the fact that the soil is probably not above the average productivity compared with neighboring farms, the owner has found profit in its cultivation.

DENVER—Feb. 18

Workmen's Compensation is earnestly considered by the present state legislature. Bills have been framed along lines followed in Wisconsin. Whereas it was generally assumed that Colorado employers would oppose such a measure, it appears that they favor it. The metal-mine operators are perhaps among those who will suffer greatest in the enforcement of this legislation for, as they explain, casualty insurance rates are very high on lives of miners and the products of their mines are sold in markets over which operators have no control. Therefore any new expense placed upon their operations simply means a lessened profit which might, in extreme cases, amount to total eclipse. At the same time they assume a favorable attitude and openly declare their approval of the general proposition that any industry should assume its own indemnities. Among those who have appeared before the legislative committees to discuss this matter is Bulkley Wells, manager of the Smuggler Union mine at Telluride, who voiced his opinions at the same session as did John McLennan, president of the United Mine Workers and the Federation of Labor. Mr. Wells' argument was that the proposed measure will bring about better relations between companies and their employees and this, in turn, will result in increased efficiency among workmen.

At the Cresson Mine, the third chapter in the story of shipment from the great vug disclosed some time ago, relates to the re-sampling of these lots at the Globe plant of the American Smelting & Refining Co., Denver. When it became apparent that the discrepancies between the Globe's first results and those obtained at the Copeland works were too wide to permit adjustment, the smeltery officials ordered resamples. This work happened to start on a very windy day and it was quickly stopped because of fears entertained by both parties in this case that the breezes would tamper with results. Later, however, the lots were completely re-rolled and again mechanically sampled. Results were remarkable checks on those from first sampling at this plant, viz., about 206 oz. gold per ton for the first class and about 105 oz. for the second class. The deadlock was established. Arrangements were then made to dispose of this ore to the Golden Cycle company and it has undergone its third shipment, this time doubling back on its track and being now at Colorado City. Its proposed treatment in a cyanide plant causes comment and it seems there may be more to relate before this stuff is finally worn out by sampling and shipping and its content removed. Meanwhile it is reported that the Cresson management is shipping another carload lot of this ore, though its destination is uncertain at this writing. Good results are reported from development on 1300-ft. level, the level next below the scene of the rich discovery.

BUTTE—Feb. 18

Henry Robinson, vice-president of the Butte Mine Workers' Union, on Feb. 12 shot Thomas Munroe, a watchman employed by the Anaconda company at the corner of Main and Park St., the busiest spot in the Butte business district, at about 6 p.m. Munroe was taken to the hospital where he died shortly afterwards. Robinson was arrested and is now awaiting trial for murder in the first degree. Reports as to the circumstances leading to the shooting are conflicting. The actual facts will probably not be known until after the trial.

The Mediation Board, appointed some time ago to bring about a reorganization of the Butte miners, submitted its report to the Silver Bow Trades and Labor Council, which was approved by this body at the regular meeting held Feb. 14. The report is as follows:

First—After extended deliberation the committee has arrived at the conclusion that the only possible way for the miners of Butte to organize is through the Western Federation of Miners. Second—After having consulted with the two factions at length and using our best efforts we conclude that neither faction has made any sincere effort in the reorganization. Third—Having reached this point we see no other way but to organize the miners of Butte regardless of either faction. Fourth—To do this we propose that an

enrollment book shall be opened for a period of 30 days, the place of enrollment to be designated later. Fifth—All miners desiring to enroll themselves under the banner of organized labor are invited to place their names upon the book and upon the payment of an initiation fee of $1 will be entitled to cast a vote for the officers of this organization. Sixth—That the mediation board supervise the initial election in the miners' union, and that thereafter the nominees for president and secretary-treasurer each name a judge and clerk to look after their interests, and that voting machines be used. Seventh—That no person now holding office in either faction of the contending organizations be eligible for office in the initial election. Eighth—That the books be audited quarterly by a firm of chartered accountants and a statement of their findings be made accessible to the membership. Ninth—That the establishment of as many locals as may be deemed necessary for the efficient transaction of the business of the organization be installed. Tenth—That a mining council be formed to be composed of delegates from the various locals and that they affiliate with the central body. Eleventh—We recommend that an appeal be made to the American Federation of Labor and the heads of international unions whose members are represented in the mining industry to send organizations to Butte and that all members of organized labor use their best endeavors to assist the miners in the work of organization.

The suggestion that a reorganization should take place through the Western Federation of Miners will probably defeat the plans of the mediation board. The great majority of Butte miners have finished with the Western Federation forever and will under no conditions submit again to the dictates of that organization. Furthermore, whether belonging to the old or the new union or to no union at all, all those now employed in the mines are content with having a job at all and are not at all anxious to bring about unavoidable trouble by reviving the animosity existing between the old and the new union and the Western Federation of Miners. Neither do they feel inclined to submit again to the excessive assessments that were the rule under that regime.

SEATTLE—Feb. 11

Ruby is Active this winter. Three big outfits are taking out winter dumps on Long Creek. Deitz, Sech & Walker, who took out profits on Mascot Creek last summer, have found equally good pay in their new shaft, some of the ground being reported to run $25 to the square foot. Graham & Johnson on the Deacon Bench claim and Buckley Bros. on Novikaket Bench are hoisting pay. Van Winkle & McKay are taking out a dump on the Buckeye claim. Al Kells is sinking a new shaft on Windy bench. Whitton & Carlson are doing well on Boston bench, as are McDonald & Warren on Warren Creek.

The Fairbanks District appears to be undergoing a revival in quartz mining, especially on the left limit of upper Fairbanks Creek. The principal mine is the Crites & Feldman, at which the main tunnel has been driven over 700 ft. into the hill on the richest of several veins. The equipment includes a 5-stamp mill, air-compressor and hammer drills for stoping. Heilig has recently moved the old Huntington mill from the Tolovana mine to Fairbanks Creek and will do custom work. This mill was entirely unsuited to the extremely hard ore at the Tolovana and was discarded when a battery of Nissen stamps was installed. It is hoped that it will do better on the softer Fairbanks Creek ores. Goyette and partners are down 30 ft. with their new shaft on the Whitehorse claim, opposite No. 11 Above, creek claim. Kleinschmidt and partners are working opposite No. 13 and G. A. Perrault opposite No. 14 Huddlestrun Bros. & McNeil are at the head of Too Much Gold Creek, a left-limit tributary of Fairbanks Creek. The vein as exposed in a 75-ft. shaft is from 2 to 3 ft. wide. There is considerable ore on the dump ready for milling and it is planned to have a run at the Heilig mill in the near future. Chris Foss and Louis Farren are driving a tunnel at the extreme head of Fairbanks Creek on the American Eagle No. 2. Rod Donaldson and partners are reported to have discovered pay on Nugget Creek, a tributary of Goldstream. Hugh Ross has also found good prospects and will put on a small plant, with the intention of taking out a winter dump.

CHICAGO—Feb. 13

In the Wisconsin and Illinois zinc districts, the high price of spelter is having a direct effect on the opening of new properties. Unusual activity is discernible, as regards both the opening of old mines and the formation of exploration companies for the drilling of new lands.

Steady Improvement in Copper Market has had good effect on actual mining operations in the Lake Superior copper country, and a better sentiment exists in that district. The announcements made not long ago that the Calumet & Hecla and its subsidiaries, commencing Feb. 6, would resume work on a full time basis, were followed shortly after by announcements that wages would be increased up to within 10% of what they were before war was declared. In addition to this, the Wolverine and Mohawk mines also announced an increase in wages. While it is a question whether the increase in consumption will continue to offset this increased production and permit the present scale of operations and pay to be continued, present plans will undoubtedly be kept in force as long as possible. In the iron country, except for the isolated cases previously noted, where the working forces have been increased somewhat, there is not such a marked improvement at the mines, although iron and steel men feel certain that such an improvement is bound to appear before long if the orders for finished products continue at the rate reported by the Steel Corporation for the past two months.

HOUGHTON—Feb. 20

Labor Agitators in Calumet found it very unhealthy last week. Finnish miners held two meetings at which they appointed committees to notify socialistic agitators that their presence was not wanted in Calumet and suggesting deportation if the reds did not leave. The men included former Western Federation agents who worked for the United Mine Workers since the abandonment of this field by Federation agents. They first attempted to cajole Finnish miners to join their union. When the miners refused they used roundabout means of suggesting to the employer that the men in question were red socialists and members of the organization. Thus the poor Finnish miner was between the devil and the deep sea. Finally the men came to the conclusion that the only way to bring peace to themselves was to rid Calumet of the agitators and trouble makers. And this they are doing in their own way.

JOPLIN—Feb. 20

Prospecting in Joplin by a new and and original method has been put in practice by a number of local operators. Throughout the district there are a large number of old drill holes which did not secure ore in paying quantities and for that reason were abandoned. It has recently been found that by shooting these holes there has been found good ore which would pay to mine. The method of doing this shooting is to fix up a charge of dynamite or nitroglycerin in a long container which will go down a drill hole which, after cleaning the hole to the desired depth, is lowered and discharged, the material thrown from the hole by the explosion of this charge is examined and is often found to carry much better ore than was shown to exist from the cuttings from the churn drill. The size of the charge ranges from one to three boxes of 40% dynamite, or approximately a quart to 1½ quarts of nitroglycerin. These charges have proven effective down to a depth of 250 to 300 ft. J. M. Short a well-known operator of the Joplin district says he has found many good prospects by shooting old holes in this manner.

The Trend of Zinc-Ore Prices is still upward. The week marked a further boost in the price of zinc ore of approximately $5 per ton, with a high base of $75 per ton of 60% metallic zinc being paid at the week end. This eclipses all former price records. It is $10.50 higher than the highest price paid in 1912 and $18 per ton stronger than in 1905, and is a raise of better than $30 per ton over the price paid not more than two months ago. This means that at the present time there is about 15 times as much profit in a ton of zinc ore in the Joplin district now as there was 60 days ago. In other words, where the mines were making about $2 per ton profit when ore was selling at $38 to $45 per ton, now they are making from $30 to $40 per ton profit with ore selling at $75 per ton base. With this unusual profit in the mining of zinc ore the Missouri-Kansas-Oklahoma zinc and lead district has never seen an era of such widespread activity. Mining land and leases are in great demand, tracts that have long been idle and allowed to fill with water are now being sought with the intention of pumping out the old workings for the production of the coveted zinc ore contained therein. With the present situation in the spelter market caused by the strong demand for spelter and the apparent lack of that metal, it is expected that the price of zinc ore will stay at high level for some time, with a possible increase over that now being paid. The only visible reason for the smashing of the high price of spelter would be a greatly increased production of zinc ore, but since it takes time to increase the production to any great extent, so it is to be expected that the zinc-mining districts are due to reap the benefit of exceedingly high prices for ore for at least four months.

The Mining News

ALASKA

GEORGE WOODMAN, a mine operator in the Chisana, will take a Keystone drill in over the ice to prospect his ground on Skookum gulch. The adjoining claim produced $30,000 to date, but Woodman has been unable to prospect his ground on account of water.

THE KOUGAROK DREDGING CO. (Cordova) — Placing dredge on Iron Creek and having machinery freighted in over the winter trails.

TREADGOLD (Dawson)—Company failed to pay employees wages due for last summer's work. Amount owing to men is reported over $100,000.

NO. 3 ABOVE, CLEARY CREEK (Fairbanks)—Fairburn & Sutherland, laymen, reported to have found good pay at bottom of new shaft recently carried to bedrock. Have started drifting and will put on small crew if pay continues.

CENTRAL CREEK (White River)—Billy James, discoverer of Chisana made placer strike on Central Creek in the upper White River Valley, 25 miles below international boundary and 75 miles above Donjek according to reports, 25 claims already staked in the new territory.

PERSEVERANCE (Thane)—New system of crushing and treating ore will be installed in plant now being built. Company preparing to handle 24,000 tons of ore per day at a profit of 75c. per ton. It is claimed that the company has 50,000,000 tons of ore already blocked out.

MOTHER LODE COPPER MINES CO. (Juneau)—Just made first shipment of ore to the Tacoma smeltery. Consisted of 250 tons high-grade ore. Other shipments will be made regularly, as company plans to ship 1500 tons during the winter. Ore is all mined and sacked ready for sledding to the railroad.

AITKEN & McKINNON PROPERTY (Georgetown)—Upper part of this property suitable for opencut operations but planned to mine lower part by drifting. Patches of thawed, wet ground will interfere with drifting. Operators worked about 22 men last summer. This said to be first real paystreak discovered in Kuskokwin Valley.

GOLDEN EAGLE MINE (Golden)—Neil Robinson has completed erection of buildings and installation of 5-stamp mill at this property. Mill will be operated by water power, but will not start up for several weeks as water is too low during winter. The work of developing mine has continued for several months and company now has considerable ore blocked out.

THOMAS-CULROSS MINING CO. (La Touche Island)—Main tunnel now in 350 ft.; good ore encountered and initial shipment of 10 tons made to Tacoma. Don Thomas, one of principal stockholders, announces company will build mill at property this summer having capacity of 50 tons a day. Meeting of stockholders held in Leavenworth, Wash., recently and authority given for construction of mill.

GOLDSTREAM—Much activity in this district, from the last reports brought out by prospectors. Stampede has been on to lower Goldstream for last few days, and many people from Ester and a few from other creeks have staked property on Goldstream below Nugget Creek. General impression is that pay will be found in good quantities. Two operators recently prospecting in the vicinity of Nugget Creek struck good pay and immediately after report circulated, the stampede started. Extent of pay has not been determined. On Goldstream proper, much prospecting is going on and output this year is expected to be great.

ALASKA CONSOLIDATED COPPER (Skagway) — Mines near Strelna under development for several years, about to start work on larger scale. Thought the several claims will be brought up to shipping stage soon. Large consignment of machinery will be shipped from the East. Company proposes to construct railroad to connect with Copper River & Northwestern in case Government does not start construction work on Federal line this year. Tunnel 1700 ft. long will be driven from Nugget Creek bed to tap deposit at great depth. Four levels already opened and several thousand tons of ore are on dump awaiting shipment. Immediate development work will cost about $200,000. Property near headwaters of Kuskalina River. Paul Dubois, Seattle, consulting engineer.

ARIZONA

Santa Cruz County

THREE STARS (Alto)—Shipment of ore made from this mine recently. Ore lead-copper with good silver content.

WORLD'S FAIR (Patagonia) — Run of ore better than formerly; reported there is much of it, oreshoot having grown in size with depth.

CONQUEST (Tubac)—Another attempt will be made to get out ore from this copper vein. Previous efforts vain, on account of enormous quantity of water encountered. James Cunningham in charge of work.

MORNING GLORY (Patagonia)—Chris Wilson, owner of this old shipper, again driving tunnel to strike vein at 400-ft. level. Work suspended when war broke out, but now attempt will be made to finish tunnel; thought it will open up large body of copper ore.

Yuma County

BILLY MACK (Parker)—Mine is improving. Vein cut on 200-ft. level.

EAGLE (Parker)—W. J. Stake & Co., lessees, are taking out copper-gold ore running from $40 to $200 per ton. It is being shipped to A. S. & R. plant at Hayden.

CALIFORNIA

Amador County

AMADOR QUEEN (Jackson)—Dominic Boro and others operating lease have cut seam of rich ore, small, with indications of widening.

PLYMOUTH CONSOLIDATED (Plymouth)—Financial returns for January show 10,200 tons ore milled. Total cost, mining and milling, $2.687 per ton.

HAYWARD (Ione)—Large vein of copper-gold ore assaying from $6 to $20 per ton found in 200-ft. crosscut from 300-ft. level. Mine formerly one of the large gold producers of Amador County. Was reopened in 1913 after 50 years' inactivity.

OLD EUREKA (Sutter Creek)—Reports again circulated that mine, owned by Hetty Green, of New York, will be reopened by Scotch company, said to be ready to buy mine. History of mine 20 years ago when Alvinza Hayward and others operated it, credits it with large production. Also reported that proposed purchase includes adjoining claims.

KEYSTONE (Amador City)—Quarterly report of C. R. Downs, general manager, shows many improvements. New hoisting gear and 300-hp. motor installed and 20 idle stamps of 40-stamp mill put in order for beginning operations. Drift on 1000-ft. level heretofore used as reservoir, reopened from shaft station, water to be stored at 900-ft. station. Over 200 ft. of drifting done on 100-ft. level, developing promising orebody 60 ft. long. East vein on 1400-ft. level will be crosscut to secure sufficient additional ore to keep 40 stamps dropping. Twenty stamps have been yielding $6000 a month.

Butte County

BUTTE CREEK CONSOLIDATED (Chico)—By terms of agreement in Superior Court this dredging company acknowledges judgment of $300 in favor of the Stanford University. University trustees brought proceedings to enjoin company from dredging on Butte Creek on ground that tailings affected land of the University. Injunction will not be pressed and company will continue operations without further objections.

Calaveras County

ECONOMIC (Esmeralda)—New orebody disclosed in raise from the 500-ft. level at point where it intersects 400-ft. level. Some delay has occurred in installation of electrical plant, but development is continued and ore is being blocked out.

Kern County

TEAGLE & MILLER (Randsburg)—Recent installation of gasoline hoist resulted in increased extraction.

SANTA ANA (Randsburg)—Lovett & Christianson driving crosscut toward Merced vein expecting to work into good ore.

KING SOLOMON (Randsburg)—Last milling of Nosser & Illingworth lease showed recovery of $80 per ton. Last company cleanup of 45½ tons at Red Dog mill recovered $50 per ton. Larger force of men contemplated. Mine capable of increased production.

Nevada County

GOLDEN CENTER (Grass Valley)—An electric pump, capacity 500 gal. per min. installed at shaft. Ten-stamp mill operating on good ore. Church Hill vein being developed at depth of 250 feet.

BEN FRANKLIN (Grass Valley) — This property and Alaska mine have been pumped out and sampled with view of determining whether or not property is to be developed under the purchase option.

NORTH STAR (Grass Valley)—Reported that Muller & Walling claims have been purchased by this company. This will increase the holdings and add to the importance of North Star control of the contact of the Deer Creek section. Claims lie between the Nevada City and Spanish mines and cover 2000 ft. along the contact. The latter named mines are included in Champion group taken over by North Star.

San Bernardino County

BARSTOW-SAN ANTONIO OIL CO. (Barstow)—Installation of machinery in progress for handling large deposit of fuller's earth, situated 35 miles northwest, near Dover oil well. Supplies and parts of machinery to be hauled from Hinkley station on Santa Fé, by caterpillar tractor. B. V. Unwin is manager.

Shasta County

ORO WATER, LIGHT AND POWER CO. (Oroville)—Reported that this company has taken options on several ranches along Clear Creek below Redding. If ground warrants it, dredge will be installed.

IGO DEVELOPMENT CO. (Igo)—Options on 4000 acres of placer land in the vicinity of Igo and 800 acres of the Menzel Ranch near Redding have been taken. Keystone drill has been installed on the Russell claims at Igo.

MOUNTAIN COPPER CO. (Keswick)—Preparations being made for the resumption of construction of new concentration plant and increased extraction of ore to meet demands of Martinez smeltery, which will resume operations on a small scale.

BALAKLALA (Coram)—Shipments of high-grade ore to Tacoma smeltery to be resumed. Resumption of ore extraction on small scale has been undertaken. Only high-grade ore will be shipped. Precipitation of copper carried in solution by the mine waters is also to be resumed. Reported that high-grade zinc ore will be shipped to Eastern plants.

Sierra County

THE EMERALD QUARTZ GROUP (Jim Crow Cañon)—This mine, owned by D. W. Smith and Wm. Shipsey, and Elsie group, owned by C. Buckingham, have been bonded to Clifford Smith and associates of San Francisco, who will push development. Claims lie near head of cañon, which in past years yielded rich placer gold.

TWENTY ONE (Alleghany)—North American Exploration Co., operating this quartz mine, being financially unable to proceed, surrendered their bond and mine was taken over by G. W. Mitchell and associates of Sacramento, who almost immediately struck a pocket of high-grade ore resembling rich finds in Tightner. Extent not yet determined.

Siskiyou County

HAPPY CAMP DISTRICT making good showing for winter season. Snake Hill operations interrupted by snow slide. Repairs will be concluded and mining resumed immediately. Shearon mine, better known as Stump, has developed gravel running from 25c. to $1 per pan. Golden Sunrise being developed under bond to Eastern men with good prospect of sale. Installation of small quartz mill contemplated. Sixes Mine, operated by Salt Lake men, running full time with good gravel in sight. Siskiyou Mines Co. operating with full crew of men, with prospect of good winter run.

Tuolumne County

NEW ALBANY (Jamestown)—Rich vein reported. Extensive development in progress.

BLACK OAK (Soulsbyville)—Deepening of shaft 100 ft. below 1700-ft. point contemplated.

Trinity County

GLOBE CONSOLIDATED (Dedrick)—New orebodies disclosed indicating the persistency of the veins below the main vein system. Twenty-stamp mill operating steadily on good ore.

Yuba County

SANDERS (Brownsville)—Rotary mill being installed at this property. Owned and operated by W. F. Sanders.

SOLANO WONDER (Brownsville)—This property formerly a producer is being reopened. Hoist installed and machinery for new mill being hauled in.

COLORADO

Boulder County

WOOD MOUNTAIN (Wallstreet)—Property being reopened on leasing system and the results of recent development are encouraging.

SUNRISE MINING & MILLING CO. (Sunset)—This company, recently organized in Denver, has purchased Copper Glance group of mines from W. J. Barrett. Vigorous campaign of development will begin at once. New company plans to expend $25,000 in development and placing property in operating condition. New air compressor will be installed and construction of a small concentrating mill considered.

Clear Creek County

OLD TOWN (Idaho Springs)—Roberts & Co., Lessees, while advancing 1200-ft. level west heading from a 100-ft. winze sunk from the 1100-ft. level, opened 7-ft. vein of pay ore. First-class ore averages 2.7 oz. gold and 1.6 oz. silver per ton. Milling ore assays 1 oz. gold and 1.15 oz. silver. Six sets of lessees now engaged in development of property, and more than half of new work in pay ore.

PRIZE MINING CO. (Idaho Springs)—This company, operating through the Newhouse tunnel, has cleaned up main east and west drifts on tunnel level of Prize workings, and plans to make 450-ft. raise to connect with bottom of the shaft from surface. It is estimated that company has about 700 ft. of stoping ground above present lower workings. Samples recently taken in back of stope above east heading on tunnel level indicate vein 1 ft. wide assaying up to $50 a ton. Breast of the west heading on same level shows stringers of ore assaying $70 a ton. Ore produced from recent preliminary development operations has paid for large proportion of work. O. B. Willmarth is manager.

Lake County

FANNY RAWLINGS (Leadville)—Leasing company, comprising members of Big Five Operating Co. that controls Big Four property, has secured Fanny Rawlings mine and will soon undertake development.

CHRYSOLITE (Leadville)—This famous old mine is being put into shape to produce zinc carbonate that was formerly considered country rock.

San Juan County

BROAD GAUGE MINING & MILLING CO. (Silverton)—This company, organized by Pueblo men, has been successfully developing Burns group of properties on Jones Mt. Main development tunnel is being advanced on the Broad Gauge vein. Breast of tunnel shows a 4-ft. vein of pay ore, including 3-ft. vein of galena ore on the foot wall and a 12-in. streak of gold quartz ore on the hanging wall. The company intends to install compressor plant and aërial tramway during coming season.

San Miguel County

PRIMOS CHEMICAL CO. (Vanadium)—After a shut down of several months this company has resumed operations. Under normal conditions plant employs about 75 men.

IDAHO

TERRIBLE-EDITH (Murray)—Under lease and bond to Charles Conn and son. Shipped one car zinc ore and another car almost loaded for shipment. Ore taken from raise. Property also has parallel shoot of lead ore.

COPPER KING (Mullan)—Report of directors Feb. 1 states work directed toward locating vein north and south of fault is apparently successful. Commercial ore in winze south of fault and promising showing on north side.

REINDEER-QUEEN (Mullan)—Drift being run to explore Queen ground has 12 ft. milling ore and 6 or 8 in. that runs 30% copper. Property convenient to railroad, fine mill site with unlimited room for tailings dump, and ample water for power and milling.

RAY-JEFFERSON (Wallace)—Purchased Carlisle claim, price understood to be $20,000. Has big showing of zinc ore. Is patented claim contiguous to company's ground and crossed by main vein. Company now has 31 claims, millsite and valuable water rights. Considering building mill this summer.

CASTLE ROCK (Wallace)—Shipment of 38 tons of ore to Tacoma smeltery returned 10.89% copper, 0.04 oz. gold, 10.5% silica and 35.7% iron, and netted company $603. Freight rate was $4 and treatment 15c. per ton. Meeting of stockholders authorized increasing regular assessment from 1 to 2 mills in order to crowd sinking shaft to 200 ft., work to be done by contract. Property on Placer Creek, 3 miles from Wallace.

MICHIGAN

Copper

NAUMKEAG (Houghton)—Naumkeag is sinking an exploratory winze with results which are fair. A narrow branch of the Pewabic lode, supposedly, now being opened with good results.

SOUTH LAKE (Houghton)—There is no more talk of a consolidation with Lake and it is believed that plan will be dropped. South Lake will be further financed by an issue of 10,000 shares of stock instead of an assessment as was generally contemplated. This will provide funds for further development. Work to date has been satisfactory. Shaft exploration has demonstrated core prophesy. New issue of stock probably out at $5 per share. Close to 70,000 shares issued, $6.60 paid in. Last assessment of $2 paid 1912. In 1909 20,000 were issued at $2 and in 1913 10,000 went out at $6.

ISLE ROYALE (Houghton)—Expects to have at least one stamp head of mill ready to go into operation by June 1, and two others 30 and 60 days later. Four fifth's of steel construction now up and wooden framework and roof on wash department completed. Three stamp-heads being dismantled and sent to Milwaukee for machine working. Most of the heavy stamp-head castings are salvaged but require some changes. Mine getting out largest tonnage in its history, supplying rock to two mills, the old Tamarack running two heads, and the Point Mills subsidiary, altogether averaging better than 2300 tons daily of rock running close to 18 lb. refined copper. Showing is particularly creditable since underground openings are being maintained at normal condition and are, in reality, showing just as good characteristics as ever in their history.

HANCOCK CONSOLIDATED (Hancock)—Resumption of operations will be accompanied by increased rock tonnage as soon as possible. Expects to increase daily tonnage up to 650 by June 1. At time of suspension general underground conditions showed rock as high grade as anticipated in the Pewabic lode at this point. The Franklin mill will be put into condition to run one head continuously on the Hancock rock. Hancock will be self supporting on a basis of 600 tons daily. Company now owes $200,000 which easily is covered by ore showings. Last assessment will pay this indebtedness and care for whatever further unusual expenses may be necessary to commercially profitable operation. Copper-country people attach unusual importance to resumption of Hancock because of John Ryan's association with it, indicating his faith in the stability of the metal situation.

MINNESOTA

Cuyuna Range

IRON MOUNTAIN (Manganese)—Contract placed on Feb. 18 with Imperial Iron Works, Duluth, for hoist, compressor, skips, etc. Erection of new power plant about completed.

Mesabi Range

GREAT NORTHERN ORE PROPERTIES (Chisholm)—Construction work started by contractors on two large coal trestles near Leonard Mine.

IROQUOIS (Virginia)—Subsequent to abandonment of this mine by Rogers, Brown Ore Co., fee owners decided to keep pumps going, and mine now remains unwatered pending decision as to future operations.

MISSOURI-KANSAS-OKLAHOMA

GALENA ROYALTY & MINING CO. (Galena, Kan.)—Another good zinc mine brought in on Muir land southwest of Galena, this is fourth mine company has struck on this 40-acre tract, has subleased last drill hole in which strike was made to operators who will commence sinking shaft on ground immediately. Body of ore was struck at 80-ft. point and continued down to 120-ft. level giving about 40-ft. face of good ore running about 8% zinc. Company recently secured several tracts of land adjoining Muir tract, which it expects to drill in near future.

MONTANA

Lewis and Clark County

SOUVENIR MINES (Helena)—Company has leased its group of mines, located in Grizzly Gulch, to George Woody. Lease calls for purchase price of $30,000. Seven men employed on property. Old Scharfer mill and stamps will be started up soon as possible. Seventy or 80 tons gold ore now on dump, and strong body of high-grade ore has been encountered in the shaft. Claims belong to the old Witlach-Union group and in early days produced large quantities of gold.

Silver Bow County

RELIANCE MINING CO. in Moose Creek country about 20 miles south of Butte active again. Operated by D. M. Adams. Work suspended in November, when water drove miners out and it became necessary to install pump along with new equipment. In interim 60-hp. boiler, No. 9 Cameron sinking pump, 35-hp. hoisting engine and remainder of surface equipment installed. Shaft now 135 ft. in depth and Mr. Adams plans to continue sinking to 200-ft. level, then crosscut and develop veins passed through above. Mr. Adams states that the country around has been pretty well located since development of his property started. Prospectors from Butte and other points have staked claims. Moose Creek district was mined for placer gold in early territorial days, but little was ever done in way of lode mining until Mr. Adams started prospecting two years ago.

NEVADA

Clark County

NEVADA DEL ORO SYNDICATE (Las Vegas)—Articles of incorporation filed; principal place of business, Las Vegas. Will take over Mahoney and Duncan claims at Railroad Pass, 20 miles east of Las Vegas in Quo Vadis mining district.

Esmeralda County

PRINCE CONSOLIDATED M. & S. CO. (Pioche)—Mill will be built. Regular shipments being made; company largest producer in Pioche district.

SIMMERONE (Goldfield)—This fraction transferred by sheriff's sale from Nevada First National Bank to Walter Trent, of Reno. Development work will begin at once.

YUBA LEASING & DEVELOPMENT CO. (Pioche)—Stated mill will be built at once as result of recent development work. Company operating Raymond & Ely property under lease.

DIAMONDFIELD BLACK BUTTE (Goldfield)—Main shaft unwatered and repaired from 150- to 300-ft. level. Work will be resumed on 300-ft. level. Winze being sunk from 100-ft. level in oreshoot assaying $2 to $40 per ton. Crosscut No. 2 on 100-ft. level opened 2-ft. shoot of $11 ore.

Humboldt County

ROCHESTER ELDA FINE (Rochester)—Articles of incorporation filed; capitalization 1,000,000 shares, $1 par value.

CROWN POINT EXTENSION (Rochester)—Lease on 350 ft. of Crown Point claim, adjoining Big Four lease, taken by Lovelock men. Work will be done through Big Four ground.

Nye County

HALIFAX (Tonopah)—Retimbering finished and production will begin at once; ore to be treated at West End mill.

TONOPAH EXTENSION (Tonopah)—Filter capacity of mill being increased 40%; new water system for fire protection being installed. Usual production.

MIZPAH EXTENSION (Tonopah)—Extensive development work including sinking of working shaft will be done. Property recently acquired by Tonopah Mining Co. and work will be done under direction of J. E. Spurr.

Ormsby County

NEW MINING BILL to permit stockholders of mining properties to inspect physical conditions as well as books being drawn; will be presented to the Legislature this session. Similar measure, but more radical, defeated four years ago.

Washoe County

GOLDEN GATE MINE (Greenhorn Dist.)—Reported stamps are dropping at new mill recently constructed on this property. Mill bins full of ore carrying free gold, and large bodies of ore blocked out in mine. Snow at mine, 4 ft. deep, caused delay in getting mill ready to run. Mill constructed by B. L. McLainas.

OREGON

ARRANGEMENTS ARE BEING MADE by a syndicate of mining men of Baker and Salt Lake, headed by L. G. Burton and James O'Toole, of Salt Lake, to develop several groups of mining claims on Cañon Mountain. This district has yielded large returns to early placer miners.

THE REDMOND COMMERCIAL CLUB hired an expert to examine black sand deposits recently found in Jefferson County. A number of assays have been made by the Club and the average of the samples run $2.60 per ton. Mining men who have lately seen and investigated the deposits say that gold can be extracted from the ore or sand at a cost of about $1 per ton, and the Club is now taking steps to verify these statements. If true the ore can be milled at a profit. Many locations of claims are being made daily.

GLEESON DEVELOPMENT CO. (Granite)—W. G. Gleeson of this company reports a breakdown of the machinery that was started up on the first of the year, so mine is shut down a few days for repairs.

LA BELLEVUE MINE (Granite)—T. S. Kennereley has completed arrangements to reopen this mine, which has been idle since 1896 through disagreement of owners. Has 7000 ft. of workings; most of it has to be retimbered.

UTAH

Salt Lake County

TAR BABY (Salt Lake)—Teams are hauling supplies to this property in Big Cottonwood, and work is to be resumed soon.

UTAH COPPER (Bingham)—A small addition has been made to working forces on account of snow. One steam shovel has been added.

MICHIGAN-UTAH (Alta)—This company is to be reorganized, and it is probable that authorization for sale of property will be asked.

SOUTH HECLA (Alta)—This company has been holding down its output throughout the winter and concentrating on development; there is a good tonnage available for shipment as soon as roads are in condition.

COLUMBUS EXTENSION (Alta)—A new strike of copper-silver ore has been made. Work on this will begin, with the completion of the new airline, which is being put in for better ventilation.

UTAH APEX (Bingham)—Sinking of Parvenue shaft 150 ft. has started. This will open Parvenue orebody, add materially to reserves of crude or smelting ores. Much development has been done in upper workings, exposing additional reserves of mill ore. There remains a large area to be developed.

UTAH POWER & LIGHT CO. (Salt Lake)—Judge Marshall, of United States District Court, ordered decree holding that Utah Power and Light Co. and Beaver River Power Co. are illegally occupying Government land and enjoining such further occupancy. Property involved is said to be worth about $15,000,000 and consists of power plants, transmission lines, reservoirs and machinery in the Cache, Filmore and Wasatch national forests of Utah. Cases have been pending about three years. Attorneys for the defendants announced they would appeal to the United States Supreme Court.

CANADA

New Brunswick

GROUP OF PLACER CLAIMS (Vernon) has been taken over by local capitalists headed by Thomas A. Russel and Samuel W. Hoag. Properties cost $55,000, and company plans immediate development and improvement. Hydraulic equipment will be installed.

SALMON-BEAR RIVER GROUP (Portland Canal)—Bonded by O. B. Bush to H. R. Plate, of New York who is putting force of 14 men on development. Diamond drill being installed. Property situated in Salmon River district, near Alaskan boundary line, about 13 miles from tidewater.

Ontario

REA (Porcupine) will pay a dividend of 6% on the $200,000 issued capital. The mine is operated by a leasing company on a 25% royalty basis, and has a 10-stamp mill, using amalgamation only.

DOMINION REDUCTION MILL (Cobalt)—Operations have been resumed after a three-weeks stoppage.

ALEXO NICKEL MINE (Porquis)—Twenty-five cars of ore have been shipped to the Mond smelter at Coniston.

NORTHERN CUSTOMS (Cobalt)—This mill, which was closed for a time owing to power shortage, is again in operation.

NIPISSING (Cobalt) has stopped work on 64 shaft on account of shortage of power. Shaft has reached depth of 1000 ft. and is deepest in the camp.

MINING CORPORATION OF CANADA (Cobalt)—Cobalt reduction mill of this company has closed down for two weeks owing to power shortage.

TRETHEWEY (Cobalt)—Staff has been officially notified that operations at mine and mill will be suspended indefinitely, 100 men will be thrown out of employment.

TOUGH OAKES (Kirkland Lake)—Mill of this company is expected to be running in March. During the past few months much treasury stock has been sold at $2.50 per share.

WETTLAUFER (Kirkland Lake)—Mine is under option to Teck Hughes Company which has adjoining property. Teck Hughes is under option to Nipissing, and recent development on bottom level shows good values, but extent of the ore shoot still in doubt.

PORCUPINE CROWN (Schumacher)—Main vein which faulted between 300- and 400-ft. level, has come in again and has been proved to a depth of 1000 ft. Mill is treating from 125 to 140 tons per day. Company negotiating for purchase of North Thompson property adjoining.

CARTWRIGHT GOLD FIELDS (Beatty Township)—A 10-stamp mill will be erected on this property, situated on Painkiller Lake, and is expected to be in operation by May. The vein shows free gold in places and is stated to assay high. A shaft is being put down to the 100-ft. level.

CROWN RESERVE (Cobalt)—This company has taken an option on large low-grade gold mine in Nicaragua and sent engineers to make examination. Deal will involve much money for development and equipment. It is understood that the Lewisohns will participate in undertaking if examination proves satisfactory.

MEXICO

Sonora

CALUMET & SONORA MINING CO.—Bondholders of company, through J. L. Lyder, Jr. and J. L. Washburn, trustees, began foreclosure proceedings in District Court, Duluth, Minn., on Feb. 11, 1915, claiming nonpayment of interest on $100,000 bonds since Mar. 6, 1914. On Feb. 1, 1911, Calumet & Sonora Mining Co. executed a trust deed to the trustees, at same time turning over 2500 shares of its stock. Pursuant to the terms of the trust deed, $100,000 in bonds were issued. Later the company suffered another reorganization. Attorneys for the company have filed their answer, admitting the company's failure to redeem the bonds or pay the interest.

AFRICA

Transvaal

GOLD PRODUCTION OF TRANSVAAL in January was 714,984 oz., being 19,847 oz. more than in December and 63,231 oz. more than in January, 1913, when the industry was recovering from the miners' strike. Number of negro laborers in the gold mines in January 172,331, or 7681 more than in December. Number in the coal mines, 8675 in January.

The Market Report

Metal Markets

NEW YORK—Feb. 24

All of the markets have been extraordinarily confused, although in different ways. Copper turned a shade weaker during the week. On the other hand, tin and lead were stronger. The extravagant rise in spelter continued.

Copper, Tin, Lead and Zinc

Copper—A fair business was done with domestic consumers at 14½@14¾c., regular terms. This was chiefly with the brass makers whose business is supposed largely to reflect European orders for the finished product. Demand from wire drawers has not exhibited any signs of material improvement. Export business has been confused more than ever by the military, shipping and financial situations. It is impossible for a seller to Europe to figure out what he is going to realize until his returns are all in.

Copper sheets base price is now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. Usual extras charged and higher prices for small quantities. Copper wire is quoted at 15@15¼c., carload lots at mill.

Exports of copper from the United States for the week ended Feb. 13 are reported by the Bureau of Commerce at 7,142,000 lb. The larger items were 5,525,000 lb. to Great Britain, 672,000 lb. to Italy, 448,000 lb. to Sweden and 251,000 lb. to Norway. Imports for the week were 2,612,000 lb. metal and 1,978,000 lb. in ore and matte: 4,590,000 lb. in all. Imports were chiefly from Cuba, Canada, Chile and Peru.

Visible stocks of copper in Europe Feb. 15 are reported as follows: Great Britain, 17,000; Rotterdam, 1150; afloat from Chile, 3200; afloat from Australia, 4700; total, 26,050 long tons, an increase of 435 tons over the Jan. 31 report.

Tin—This market has been a much mixed affair on account of the topsy-turvy conditions abroad. The advance recorded here simply reflects the advance in London. The volume of business done here was very small.

Exports of tin from the South China fields for the year 1914 are reported by U. S. Consul George E. Anderson at Hongkong at 51,235 slabs, against 77,412 slabs in 1913. The 1914 exports were equal to 2562 long tons; the destinations were: Great Britain, 282 long tons; other Europe, 1045 tons; United States, 1235 tons; total, 2562 long tons.

Tin production of the Federated Malay States in January is reported at 4983 long tons in 1914, and 3995 in 1915; a decrease of 988 tons.

Lead—There continued to be conflicting reports about this market. In sifting them all, the conclusion is unescapable that business is poor among domestic consumers, but that a strong demand from Europe continues right along which is the backbone of the market and supports the latter very well so long as the production remains curtailed. Lead has been going from St. Louis to Europe via Southern ports, and the filling of foreign orders from St. Louis is supposed to be the explanation of the rise in the St. Louis price above the normal differential.

Spelter—There is no longer any wholesale market in spelter for spot and prompt deliveries for the reason that all supplies, except occasional odd lots, have been exhausted. Any belated consumer who must have immediate delivery is obliged to pay a fancy premium. The wholesale business is now being done for April and later deliveries. Domestic consumers have heretofore been reluctant to consider such purchases, but during the last week they began to take a new view of the situation and bought some rather large tonnages. The prices paid varied according to the delivery, the bulk of the business, being apparently done at about 8¼@8¾c. The high prices here tempted European buyers who resold contracts previously made, accepting from 8⅛c. for March-April, up to 9c. for prompt, St. Louis basis. On the other hand, England was unwilling to buy futures at anything over an 8c. basis. American producers are practically cleared out for March delivery. On the other hand, domestic consumers who have previously been uncovered are now believed to have arranged for what they need, and demand from them is no longer urgent. Demand for brass special is reported as having abated.

It has been rumored that some Australian ore is coming into this country for smelting here.

It is reported that the smelting works at Caney, Kan., are to be put into operation immediately. Resumption of smelting at Altoona, Kan., is also contemplated. Smelters in many quarters report firing of additional furnaces.

During the week ending Feb. 6, Germany put an embargo on spelter and exportation is now permitted only in small quantities, to neutral countries, and under governmental supervision.

Zinc sheets are a little higher and are quoted today at $12.50 per 100 lb. f.o.b. La Salle, Ill., less 8% discount. Usual extras charged.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc	
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.
18	4.8175	48⅛	14.40 @14.55	37	3.85	3.72½ @3.77½	8.30 @9.05	8.12½ @8.87½
19	4.8175	48⅛	14.40 @14.55	39¼	3.85	3.75 @3.80	8.30 @9.17½	8.12½ @9.00
20	4.8100	48⅛	14.40 @14.55	39¼	3.85	3.75 @3.80	8.30 @9.30	8.12½ @9.12½
22	.....	...	.....	..	....	.....	.....	.....
23	4.8000	48⅛	14.35 @14.55	39	3.85	3.77½ @3.82½	8.42½ @9.42½	8.25 @9.25
24	4.7913	48⅛	14.35 @14.55	38	3.85	3.77½ @3.82½	8.42½ @9.42½	8.25 @9.25

The quotations herein are our appraisal of the markets for copper, lead, spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The difference between the price delivered and the New York cash equivalent is at present 0.15 to 0.20c. on domestic business and 0.25 to 0.37½c. on European. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Western brands. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are; St. Louis-New York, 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.	Silver	Copper				Tin		Lead		Zinc	
		Spot		3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
		£ per Ton	Cts. per Lb.								
18	22 13/16	63½	13.79	63¾	....	178	156½	19 7/16	4.22	40	8.60
19	22⅞	63¾	13.85	64¼	....	184	161	19 7/16	4.22	41⅛	9.02
20	22⅞	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	22⅞	64⅛	13.99	64¼	....	186	164	19 7/16	4.22	42⅛	9.15
23	22 13/16	64⅛	14.07	65	....	180	159	19 7/16	4.22	41⅛	9.10
24	22⅞	64⅛	14.07	65¼	....	177	...	20	4.35	42⅛	9.15

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10=2.17½c.; £15=3.26¼c.; £20=4.35c.; £30=6.52c.; £60=13.05c. Variations, £1 = 0.21¾c.

Other Metals

Aluminum—There has been no especial incident in this market and conditions are about the same, with moderate sales. Quotations are 19@19.50c. per lb. for No. 1 ingots, New York—**Antimony** remains strong. Business has not been heavy for the week, but there is some concern about supplies. Ordinary brands sell at 18@19c. per lb.; while 21@22c. per lb. is asked for Cookson's—**Nickel** is unchanged, ordinary forms being 40@45c. per lb. according to size and terms of order. Electrolytic, 3c. higher—**Quicksilver** continues strong and prices are again advancing. Bids of $58 in the early part of the week were not closed. The large dealers ask $62 per flask of 75 lb., New York. San Francisco, $60 for domestic orders. London price is £12 10s. per flask.

Minor Metals—Current sales of **Bismuth** have been at $2.75 per lb., New York. **Selenium**—Quotations are $2@3 per lb. for larger quantities; $4.50@5 per lb. for smaller lots.

Gold, Silver and Platinum

Gold—Foreign exchange continues low, and there is talk of more gold imports. None have been actually made yet.

Gold production in the Transvaal in January was $14,778,719, against $14,368,482 in December and $13,471,735 in January, 1913. Production of the Kolar gold field, Mysore, India, was $978,807. The Kolar returns for January are made for the first time in fine gold; heretofore they have been made in ounces of bullion.

Gold imports in Great Britain in January were £1,358,776; exports, £726,733; excess of imports, £632,043, against £3,722,055 for January of last year.

Platinum—Nothing new has developed and the market is quiet and unchanged. Dealers ask $40@42 per oz. for refined platinum, but sales have been made as low as $38, so that we must still give $38@42 as the range of prices. Hard metal is $44@49 per oz., according to the iridium content.

Iridium—This metal is still scarce and high in price. It is difficult to give any general price, as each sale seems to stand by itself.

Silver—The market continues quiet with moderate orders at current prices. So far this year the shipments to India have exceeded those of 1914. In 1914 they amounted under date of Feb. 4 to £567,000, while in the current year they have been £678,000 in all.

Exports of silver from London to the East Jan. 1 to Feb. 11, as reported by Messrs. Pixley & Abell:

	1914	1915	Changes
India	£568,500	£881,500	I. £313,000
China	10,000	.....	D. 10,000
Total	£578,500	£881,500	I. £303,000

Silver imports in Great Britain in January were valued at £1,069,485; exports, £656,307; excess of imports, £413,178, which compares with an excess of exports amounting to £200,079 in January of last year.

Other Ores

The Carnegie Steel Co.'s new schedule, dated Aug. 5, gives prices per ton of 2240 lb. for domestic manganese ore delivered at Pittsburgh or Etna, Penn., or at South Chicago, Ill., as follows: 49% metallic manganese, 26c. per unit; 46 to 49%, 25c.; 43 to 46%, 24c.; 40 to 43% manganese, 23c. per unit. This is an advance of 1c. per unit over the old list.

Prices are based on ores containing not more than 8% silica or 0.20% phosphorus and are subject to deductions as follows: For each 1% in excess of 8% silica there shall be a deduction of 15c. per ton; fractions in proportion. For each 0.02%, or fraction thereof, in excess of 0.20% phosphorus there shall be a deduction of 2c. per unit of manganese per ton.

Ores containing less than 40% manganese or more than 12% silica or 0.225% phosphorus are subject to acceptance or refusal at the buyer's option.

Settlements are based on analysis of sample dried at 212° F., the percentage of moisture in the sample as taken being deducted from the weight.

Fuel production of Austria, year ended Dec. 31, in metric tons:

	1913	1914	Changes
Coal mined	16,466,972	15,073,132	D. 1,393,840
Brown coal	27,276,259	23,772,069	D. 3,504,190
Coke made	2,584,281	2,189,913	D. 395,368
Briquettes made	438,099	424,863	D. 13,236

Of the briquettes reported in 1914 a total of 230,642 tons were made from brown coal or lignite. The decreases shown were all in the second half of the year.

Exports and imports of secondary metallic products in the United States year ended Dec. 31, in pounds:

	Exports		Imports	
	1913	1914	1913	1914
Copper sulphate	4,168,675	7,387,236	.....	.....
White lead	15,062,384	17,645,538	.....	.....
Zinc oxide	28,932,953	31,183,369	.....	.....
Zinc dust	186,138	356,262	4,382,470	4,604,107
Zinc dross	56,696	5,051,067	.....	.....

Exports include reëxports of foreign material.

Zinc and Lead Ore Markets

JOPLIN, MO.—Feb. 20

Blende, high price, $78; assay base 60% zinc $65@75; metal base 60% zinc $65@70; calamine base 40% zinc $42@46; average, all grades of zinc, $68 per ton. Lead, high price $49; base $47 per ton of 80% metal content; average, all grades of lead, $47.60.

Blende low in lead was in strong demand and practically all containing less than 0.05% lead was purchased. The demand for other grades was strong, but at offerings of $65@70 and sellers declined to accept. It is evident from recent purchases that the present call at high prices is for low lead content, with a reduction of $1 per ton for each 0.01% of lead over 0.05%. This is drawing a line very sharply, and producers who realize the situation are improving concentration methods to meet the new demand.

SHIPMENTS, WEEK ENDED FEB. 20

	Blende	Calamine	Lead	Values
Totals this week...	11,400,020	1,096,000	1,333,270	$456,590
Totals this year....	82,281,780	7,660,990	11,991,450	2,786,840

Blende value, the week, $400,740; 8 weeks, $2,374,610.
Calamine value, the week, $24,120; 8 weeks, $130,930.
Lead value, the week, $31,730; 8 weeks, $281,300.

PLATTEVILLE, WIS.—Feb. 20

The base price paid this week for 60% zinc ore was $70@72 per ton. The base price paid for 80% lead ore was $48 per ton. This week's shipment is increased one-fourth by including the tonnage curtailed and unreported on account of the snow blockade of two weeks ago.

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur Ore, Lb.
Week	5,647,220	79,000	330,000
Year to date	30,103,860	305,000	2,876,300

Shipped during week to separating plants, 4,381,320 lb. zinc ore.

Iron Trade Review

NEW YORK—Feb. 24

There is no break in the slow improvement in business and the trade is becoming more and more hopeful of the future as times goes on.

Structural steel is about the slowest side of the market, and not much improvement can be reported there. In other lines the change is all for the better, though the movement is not rapid. The railroads are coming into the market rather slowly for rails and cars. Some more export orders have been quietly placed.

The Algoma Steel Co. at Sault Ste. Marie, Ont., has taken several more orders for rails for the United States, the lower prices offered proving attractive.

The pig-iron market shows some improvement, and February will probably show an increase in production. Some Alabama pig is reported taken for export.

PITTSBURGH—Feb. 23

The steel market is holding its own, and no more. Orders have not been increasing in the past week or two, but they are as heavy as 30 days ago. Mill operations have increased slightly but now, with an average operation of 55 or 60% of capacity, they are at the summit unless orders increase further. Any decrease in buying would be reflected promptly in decreased operations, as the mills have no large tonnage ahead. There is extremely little railroad material being made, and very little structural material is going to the mills. Export business is about the same as for several months past. The most active buying has been by jobbers and ordinary manufacturing consumers, with a very good volume of line pipe and tank work.

Bars, plates and shapes have lately been quoted at 1.10c. for February specification, 1.15c. for March and 1.20c. for second quarter. It is believed that the 1.10c. quotation will disappear at the end of the month, putting the market squarely at a minimum of 1.15c. next week. Large buyers are well covered by contracts already made at 1.10c. for first quarter and 1.15c. for second quarter.

Most mills have advanced galvanized sheets to 2.40c. and are quoting this price only for immediate specification and early shipment. The scarcity of spelter has forced the galvanized sheet market up by about $15 a ton, but there is of course practically no buying.

Pig Iron—The market is still regarded as being between seasons, with little activity but prices well maintained at $13.60 for bessemer, $12.50 for basic, $12.75@13.25 for foundry, $12.75 for malleable and $12.50@12.75 for forge, at valley furnaces, 95c. higher delivered Pittsburgh. A detached merchant stack in western Pennsylvania is considering the question of going into blast, to take care of its regular trade.

Ferromanganese—Steel mills still have nothing like any promise as to when shipments of ferromanganese from England will be resumed. Stocks are variously estimated at from three to six months' supply at the present rate of consumption. Small prompt lots are dearer, being usually quoted at about $100, Baltimore.

Steel—There is no activity in billets or sheet bars, consumers being covered by contracts. There are one or two low sellers at Youngstown, where about $18.25 for billets and $18.50@19 for sheet bars could be done, the Pittsburgh market being $1 higher, representing the freight. Rods are $25, Pittsburgh.

Exports and Imports of Iron and Steel, including machinery, in the United States for the year ended Dec. 31 are valued as below by the Department of Commerce.

	1913	1914	Changes
Exports	$293,134,160	$199,861,684	D. $93,272,476
Imports	33,601,985	28,615,344	D. 4,986,641
Excess, exports	$259,532,175	$171,246,340	D. $88,285,835

The decrease in exports was 31.8%, which was accompanied by a decrease of 14.8% in imports.

COKE

Coke production in the Connellsville region for the week is reported by the "Courier" at 250,855 short tons; shipments, 249,543 tons. Production of Greensburg and upper Connellsville districts, 34,345 tons.

Connellsville Coke—The market is absolutely stagnant and prices are more or less nominal, at about $1.50@1.55 for prompt furnace, $1.65 for contracts to July 1, $1.75 for contracts to the end of the year, $2@2.20 for prompt foundry and $2.20@2.30 for contract foundry, per net ton at ovens.

Exports and imports of fuel in the United States year ended Dec. 31, in long tons:

	Exports		Imports	
	1913	1914	1913	1914
Anthracite	4,154,386	3,830,244	921	19,347
Bituminous	17,986,757	13,801,850	1,413,857	1,375,316
Coke	881,603	592,487	93,507	120,777
Bunker coal	7,700,520	7,266,002	.....	.....
Total	30,723,266	25,490,583	1,508,285	1,515,440

The bunker coal, or coal furnished to steamships in foreign trade, is almost wholly bituminous. The coal export trade has lost the heavy increase made in 1913 and has fallen off almost to the level of 1912. The chief trade, both exports and imports, is with Canada; other large items of bituminous exports were 1,075,824 tons to Cuba, 552,000 to the West Indies, 359,802 to Mexico, 278,026 to Brazil, 267,598 to Panama and 241,248 to Argentina.

Lake Coal Tonnages for the full season are given below for three years past in short tons, showing the origin of the shipments:

From	1912	1913	1914
Pittsburgh District	11,300,000	13,415,473	11,195,000
Ohio	4,676,000	6,176,624	1,363,000
West Virginia and Virginia	7,360,000	8,736,586	9,106,000
Other districts	.....	.....	1,332,000
Total bituminous	23,336,000	28,328,683	22,996,000
Anthracite	4,204,741	5,033,696	4,285,228
Total	27,540,741	33,362,379	27,281,228

The tonnage of 1914 was about the same as that of 1912, but was less than that of 1913 by 6,081,151 tons, or 18.2%. The coal from other districts included 436,000 tons from western Pennsylvania outside of the Pittsburgh District, and 896,000 tons from Kentucky. The small shipments from Ohio in 1914 were due to the long strike in that state.

IRON ORE

Imports of iron ore into Great Britain month of January 528,325 long tons in 1914, and 365,812 in 1915; decrease, 162,513 tons. Imports of manganese ore 60,683 tons in 1914, and 39,413 tons in 1915; decrease 21,270 tons.

Imports and exports of iron ore in the United States, year ended Dec. 31, in long tons:

	1913	1914	Changes
Imports	2,594,770	1,351,368	D. 1,243,402
Exports	1,042,051	551,618	D. 490,433

The large imports of iron ore in 1914 were 815,017 tons from Cuba, 280,887 tons from Sweden, 66,982 tons from Spain, 52,514 tons from Canada, 38,515 tons from Newfoundland. Exports were chiefly to Canada.

FOREIGN IRON

The Number of Furnaces in Blast in Great Britain Dec. 31, 1914, was 294, or six more than on Sept. 31. The average number active during the December quarter was 293, being 12 more than in the September quarter.

The German Iron & Steel Union reports the total make of pig iron in Germany in December, 1914, at 853,881 metric tons, which compares with 788,956 tons in November and 1,611,250 tons in December, 1913. For the year ended Dec. 31 the output compares with the previous year as follows, in metric tons:

	1913	1914	Changes
Foundry iron	3,657,326	2,494,527	D. 1,162,799
Forge iron	489,783	370,257	D. 119,526
Steel pig	2,599,887	1,996,786	D. 603,101
Bessemer pig	368,840	237,988	D. 130,852
Thomas (basic) pig	12,193,336	9,289,989	D. 2,903,347
Total	19,309,172	14,389,547	D. 4,919,625

Steel pig includes spiegeleisen, ferromanganese, ferrosilicon and all similar alloys. The total decrease is 25.5%, which is less than might have been expected.

Chemicals

NEW YORK—Feb. 24

The stockholders of the General Chemical Co. have voted to authorize increases of $5,000,000 in the preferred and $7,500,000 in the common stock, making the total amount of each class $20,000,000. All of the new stock to be issued now is $260,000 preferred in exchange for stock of the General Chemical Co. of California.

Arsenic—The market remains quiet with no material change and fair supplies. Quotations are steady, at $3.75@ per 100 lb., for both spot and futures.

Copper Sulphate—Business is fair with little change from recent reports. The quotations have been again advanced 25c. and are now $5.25 per 100 lb. for carload lots, and $5.50 for smaller orders.

Nitrate of Soda—Business is still a little irregular, with more or less activity. The current quotations are 2.12½c. per lb. for spot and March-June; 2.07½c. for June-December, and 2.05c. for 1916 deliveries.

Messrs. W. Montgomery & Co., London, give the following statement of the position of nitrate for the year ended June 30, in long tons:

	1911-12	1912-13	1913-14
Shipment from S. America	2,456,000	2,647,000	2,660,000
Consumption, United Kingdom	132,000	125,000	122,000
Consumption, other Europe	1,711,000	1,689,000	1,868,000
Consumption, United States	503,000	583,000	553,000
Consumption, other countries	114,000	86,000	90,000
Total	2,460,000	2,483,000	2,633,000
Visible supply June 30	318,000	420,000	418,000

Visible supplies include stocks in the United Kingdom and on the Continent of Europe and quantities afloat from South American ports on June 30, the end of the fiscal year.

Pyrites—Imports at Baltimore for the week included 4049 tons of pyrites from Huelva, Spain.

Sulphur—Late advices from Japan report increased production of sulphur in Hokkaido. The total for 10 months of 1914 was 85,148,000 lb., an increase of 27,000,000 lb. over 1913. There was an increase in the exports to the Pacific Coast of the United States.

Imports and Exports of Fertilizing Chemicals in the United States, year ended Dec. 31, in long tons:

	Imports		Exports	
	1913	1914	1913	1914
Kainit	465,850	329,611	140	300
Manure salts	223,292	168,426	.....	.....
Other potash salts	253,300	204,773	3,419	3,911
Nitrate of soda	625,862	543,715	5,560	9,220
Sulphate of ammonia	58,281	74,121	.....	263
Phosphates	.....	.....	1,364,508	964,114

Exports include reëxports of foreign material. Some phosphates are imported, but are not given separately in the returns.

Assessments

Company	Delinq.	Sale	Amt.
Belcher Silver, Nev	Feb. 8	Mar. 1	$0.10
Booth, Nev	Jan. 25	Mar. 1	0.02
Brunswick Con., Nev	Feb. 16	Mar. 9	0.01
Caledonia, Nev	Mar. 8	Mar. 31	0.05
Cedar-Talisman, Utah	Feb. 8	Mar. 1	0.005
Clear Grit, Ida. (post.)	Feb. 9	Mar. 3	0.0015
Confidence, Nev	Mar. 11	Mar. 31	0.10
Con. Virginia, Nev	Feb. 24	Mar. 18	0.10
Copper King, Ida	Mar. 1	Apr. 1	0.005
East Hercules, Ida. (post.)	.....	Mar. 3	0.001
Emerald, Utah (three instal.)	.....	June 9	0.01
Gethin Le Roy, Utah (post.)	Feb. 16	Mar. 7	0.02
Idaho-Nevada, Ida	Mar. 10	Apr. 2	0.002
Index, Ida	Feb. 27	Mar. 27	0.005
Indiana, Mich	Feb. 4	.....	1.00
Iron King, Ida	Feb. 18	Mar. 19	0.001
Jack Waite, Ida	Mar. 1	Mar. 24	0.01
Kentuck, Nev	Mar. 18	Apr. 7	0.02
Keystone, Utah. (post)	Feb. 23	Mar. 23	0.02
King Pine Crk., Ida	Feb. 12	Mar. 13	0.002
Laclede, Ida	Mar. 20	Apr. 6	0.003
Majestic-Idol, Nev	Dec. 15	Jul. 20	0.005
Manhattan Con., Nev	Feb. 30	Mar. 1	0.01
Nor. Bnkr. Hill, Ida	Jan. 30	Mar. 6	0.002
Ophir, Nev	Feb. 11	Mar. 5	0.10
Oreano, Ida	Mar. 25	Apr. 26	0.0015
Overman, Nev	Mar. 8	Mar. 26	0.05
Pioche Coalition, Nev	Feb. 10	Mar. 1	0.025
Reindeer-Queen, Ida	Feb. 15	Mar. 8	0.003
Rescue-Eula, Nev	Feb. 11	Mar. 22	0.01
Saltese, Ida	Mar. 1	Apr. 1	0.002
Selma, Utah	Mar. 20	Apr. 6	0.0025
Sierra Nevada, Nev	Feb. 8	Mar. 2	0.05
Snowstorm Ex., Ida	Feb. 19	Mar. 22	0.003
Sonora, Ida	Mar. 15	Apr. 15	0.002
Syndicate, Ida. (post.)	.....	Jan. 28	0.001
Tarbox, Ida. (post.)	Jan. 28	Mar. 25	0.0025
Tar Baby, Utah	Mar. 5	Apr. 5	0.005
Tonopah Midway, Nev	Mar. 12	Apr. 12	0.01
Torino, Ida	Feb. 20	Mar. 20	0.001
Utah-United, Utah	Feb. 20	Mar. 15	0.01
Verde May, Ida	Feb. 1	Mar. 1	0 001
Wolf Mountain, Utah	Mar. 15	Apr. 14	0.0015

Stock Quotations

The past week has been characterized by weakness in the stock market, bringing many standard stocks nearly down to the Exchange's "minimum" prices.

COLO. SPRINGS	Feb. 23	SALT LAKE	Feb. 23
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	.05	Beck Tunnel	.06
Cripple Cr'k Con	‡.01	Black Jack	.08½
C. K. & N	.06½	Colorado Mining	.10
Doctor Jack Pot	.08	Crown Point	.01½
Elkton Con	.47½	Daly-Judge	5.25
El Paso	1.70	Gold Chain	.08½
Findlay	.02½	Grand Central	.62
Gold Dollar	.04	Iron Blossom	.98
Gold Sovereign	.04½	Little Bell	.10
Isabella	.16½	Lower Mammoth	.05½
Jack Pot	.06½	Mason Valley	1.10
Jennie Sample	.02	May Day	.12½
Jerry Johnson	.03½	Opohongo	.01½
Lexington	‡.009	Prince Con	.44
Old Gold	‡.01	Seven Troughs	.02½
Mary McKinney	.31½	Silver King Coal'n	3.00
Pharmacist	.01½	Silver King Con	1.92½
Portland	1.10	Sioux Con	.03½
Raven B. H	.02½	Uncle Sam	.05½
Vindicator	1.25	Yankee	.07

TORONTO	Feb. 23		
Bailey	.02	Dome Exten	.07
Coniagas	4.75	Foley O'Brien	.15
Peterson Lake	.22	Hollinger	22.00
Right of Way	.02	Imperial	.01
Seneca Superior	1.25	Jupiter	.09
Silver Queen	.02	McIntyre	.33
T. & Hudson Bay	20.00	Pearl Lake	.02
Timiskaming	.16	Porcu. Gold	.25
Wettlaufer-Lor	.05	Preston E. D	.01
Big Dome	5.60	Rea	.12

SAN FRANCISCO	Feb. 23		
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.19	Belmont	3.75
Belcher	.23	Jim Butler	.67
Best & Belcher	.06	Lone Star	.08
Caledonia	.20	MacNamara	.03
Challenge Con	‡.05	Midway	.12
Confidence	.12	Mont.-Tonopah	.48
Con. Virginia	.14	North Star	.14
Crown Point (Nev.)	‡.19	Rescue Eula	.10
Gould & Curry	.02	West End Con	.53
Hale & Norcross	.04	Atlanta	.26
Julia	.01	Booth	.32
Mexican	.41	C.O.D. Con	.05
Occidental	.80	Comb. Frac	.07
Ophir	.13	Jumbo Extension	.76
Overman	.07	Pitts.-Silver Peak	.10
Potosi	.01	Round Mountain	.39
Savage	.04	Sandstorm Kendall	.08½
Sierra Nevada	.12	Silver Pick	.06
Union Con	.21	Central Eureka	‡.25
Yellow Jacket	.30	So. Eureka	‡2.25

N. Y. EXCH.	Feb. 23	BOSTON EXCH	Feb. 23
Name of Comp.	Clg.	Name of Comp.	Clg.
Amalgamated	51½	Adventure	1
Am.Sm.&Ref.,com	61	Ahmeek	250
Am. Sm. & Ref., pf.	99	Alaska Gold M	27½
Am. Sm. Sec., pf. B	‡78	Algomah	.50
Anaconda	25½	Allouez	39½
Batopilas Min	.50	Am. Zinc	22
Bethlehem Steel, pf.	103½	Ariz. Com., ctfs.	4
Chino	34	Bonanza	.31
Colo. Fuel & Iron	23½	Butte-Ballaklava	2½
Federal M. & S., pf.	‡26	Butte & Superior	45½
Great Nor., ore., ctf.	29	Calumet & Ariz	52
Guggen. Exp	48½	Calumet & Hecla	380
Homestake	115½	Centennial	16½
Inspiration Con	18	Copper Range	33
Mex. Petroleum	63½	Daly West	2½
Miami Copper	18½	East Butte	9
Nat'l Lead, com	48	Franklin	4½
National Lead, pf	106	Granby	65
Nev Consol	12	Hancock	11½
Ontario Min	2	Hedley	29
Phelps Dodge	175	Helvetia	.25
Quicksilver, pf	1½	Indiana	3½
Ray Con	16	Island Cr'k, com	44
Republic I&S, com	19½	Island Cr'k, pfd	87
Republic I&S, pf	72½	Isle Royale	20
SlossSheffi'd, com	24	Keweenaw	2½
Sloss Sheffield, pf	‡82	Lake	5½
Tennessee Copper	26½	La Salle	3½
Utah Copper	50	Mass	4½
U. S. Steel, com	41	Mayflower	4½
U. S. Steel, pf	103½	Michigan	.60
		Mohawk	53
N. Y. CURB	Feb. 23	New Arcadian	4½
Name of Comp.	Clg.	New Idria Quick	‡3½
		North Butte	23
Beaver Con	.26	North Lake	1½
Big Four	.07	Ojibway	‡.70
Blue Bell	.04	Old Colony	3½
Braden Copper	6½	Old Dominion	41½
Buffalo Mines	.75	Osceola	66
Can. Cop. Corpn	1 5/16	Quincy	55
Can. G. & S	.03	Santa Fe	1½
Caribou	.50	Shannon	5½
Chambers Ferland	.12	Shattuck-Ariz	20½
Con. Ariz. Sm	.25	Superior	26½
Coppermines Cons	‡1½	Superior & Bost	1½
Davis-Daly	.90	Tamarack	29½
Diam'field-Daisy	.08	Trinity	2½
Dia. Black B	.04	Tuolumne	.25
Ely Con	‡.01	U. S. Smelting	21
Florence	.60	U. S. Smelt'g, pf	41
Goldfield Con	1 9/16	Utah Apex	2
Goldfield Merger	.24	Utah Con	9½
Greene Cananea	24½	Victoria	1½
Kerr Lake	4½	Winona	1½
La Rose	7/8	Wolverine	49½
McKinley-Dar-Sa	.42	Wyandot	.50
Mines of Am	2½		
Mutual Min., pf	‡2½	BOSTON CURB	Feb. 23
Nevada Hills	.28	Name of Comp.	Bid.
New Utah Bingham	‡ 1/16		
Nipissing Mines	5½	Alvarado	.60
Ohio Copper	.09	Bingham Mines	‡3½
Oro	.10½	Boston Ely	.14
Pacific Smelt	½	Butte & Lon'n Dev	.19
South Utah	10	Calaveras	1 1/16
Stand'd Oil of N.J	387	Calumet-Corbin	.12
Standard S. L	1½	Chief Con	.70
Stewart	2 1/16	Corbin	‡1
Tonopah	6½	Cortez	.25
Tonopah Ex	2½	Crown Reserve	.73
Tonopah Merger	.39	Eagle & Blue Bell	.75
Tularosa	1/16	First Nat. Cop	1
West End Ex	.03	Houghton Copper	1½
Yukon Gold	2½	Iron Cap Cop., pf	‡5
		Majestic	.10
LONDON	Feb. 11	Mexican Metals	.13
		Nevada-Douglas	.30
Alaska Tre'dwell	£7 12s 6d	New Baltic	1½
Camp Bird	0 7 6	Oneco	‡.60
El Oro	0 9 9	Raven Copper	.09
Esperanza	0 9 6	Smokey Dev	.10
Mexico Mines	4 2 6	So. Lake	4½
Oroville	0 12 6	Tonopah Victor	‡.17
Philippine Dr	1 0 0	Trethewey	.08
Santa Gert'dis	0 11 3	United Verde Ext	2 9/16
Tomboy	1 3 9		
Tough Oakes	0 13 9		

‡Last Quotations.

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1913	1914	1915	1913	1914	1915
January	62.938	57.572	48.855	28.983	26.553	22.731
February	61.642	57.506	.....	28.357	26.573	.....
March	57.870	58.067	.....	26.669	26.788	.....
April	59.490	58.519	.....	27.416	26.958	.....
May	60.361	58.175	.....	27.825	26.704	.....
June	58.990	56.471	.....	27.199	25.948	.....
July	58.721	54.678	.....	27.074	25.219	.....
August	59.293	54.344	.....	27.335	25.979	.....
September	60.640	53.290	.....	27.986	24.260	.....
October	60.793	50.654	.....	28.083	23.199	.....
November	58.995	49.082	.....	27.263	22.703	.....
December	57.760	49.375	.....	26.720	22.900	.....
Year	59.791	54.811	.....	27.576	25.314	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York		London			
	Electrolytic		Standard		Best Selected	
	1914	1915	1914	1915	1914	1915
January	14.223	13.641	64.304	60.756	69.488	65.719
February	14.491	.....	65.259	.....	70.188	.....
March	14.131	.....	64.776	.....	69.170	.....
April	14.211	.....	64.747	.....	69.313	.....
May	13.996	.....	63.182	.....	67.786	.....
June	13.603	.....	61.836	.....	66.274	.....
July	13.223	.....	60.540	.....	64.955	.....
August	*	.....	‡	.....	‡	.....
September	*	.....	‡	.....	‡	.....
October	*	.....	‡	.....	‡	.....
November	11.739	.....	53.227	.....	*	.....
December	12.801	.....	56.841	.....	*	.....
Year	13.602	.....	61.524	.....	68.168	.....

TIN

Month	New York		London	
	1914	1915	1914	1915
January	37.779	34.260	171.905	156.550
February	39.830	.....	181.556	.....
March	38.038	.....	173.619	.....
April	36.154	.....	163.963	.....
May	33.360	.....	150.702	.....
June	30.577	.....	138.321	.....
July	31.707	.....	142.517	.....
August	*	.....	‡	.....
September	32.675	.....	‡	.....
October	30.284	.....	‡	.....
November	33.304	.....	139.391	.....
December	33.601	.....	147.102	.....
Av. year	34.301	.....	156.564	.....

LEAD

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	4.111	3.729	4.011	3.548	19.665	18.606
February	4.048	.....	3.937	.....	19.606	.....
March	3.970	.....	3.850	.....	19.651	.....
April	3.810	.....	3.688	.....	18.225	.....
May	3.900	.....	3.808	.....	18.503	.....
June	3.900	.....	3.810	.....	19.411	.....
July	3.891	.....	3.738	.....	19.051	.....
August	3.875	.....	3.715	.....	‡	.....
September	3.828	.....	3.658	.....	‡	.....
October	3.528	.....	3.384	.....	‡	.....
November	3.683	.....	3.585	.....	18.500	.....
December	3.800	.....	3.662	.....	19.097	.....
Year	3.862	.....	3.737	.....	19.079	.....

SPELTER

Month	New York		St. Louis		London	
	1914	1915	1914	1915	1914	1915
January	5.262	6.386	5.112	6.211	21.533	30.844
February	5.377	.....	5.228	.....	21.413	.....
March	5.250	.....	5.100	.....	21.460	.....
April	5.113	.....	4.963	.....	21.569	.....
May	5.074	.....	4.924	.....	21.393	.....
June	5.000	.....	4.850	.....	21.345	.....
July	4.920	.....	4.770	.....	21.568	.....
August	5.568	.....	5.418	.....	‡	.....
September	5.380	.....	5.230	.....	‡	.....
October	4.909	.....	4.750	.....	‡	.....
November	5.112	.....	4.962	.....	25.016	.....
December	5.592	.....	5.430	.....	27.369	.....
Year	5.213	.....	5.061	.....	22.544	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton. * Not reported, ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1914	1915	1914	1915	1914	1915
January	$14.94	$14.59	$13.23	$13.45	$13.99	$13.90
February	15.06	.....	14.12	.....	14.08	.....
March	15 07	.....	13.94	.....	14.10	.....
April	14.90	.....	13.90	.....	14.13	.....
May	4.90	.....	13.90	.....	14.27	.....
June	14.90	.....	13.90	.....	13.96	.....
July	14.90	.....	13.90	.....	13.90	.....
August	14.90	.....	13.90	.....	14.08	.....
September	14.90	.....	13.90	.....	14.03	.....
October	14.84	.....	13.75	.....	13.97	.....
November	14.59	.....	13.43	.....	13.83	.....
December	14.70	.....	13.45	.....	13.83	.....
Year	$14.88	.....	$13.78	.....	$14.01	.....